PHOTOMULTIPLIER TUBE MODULES

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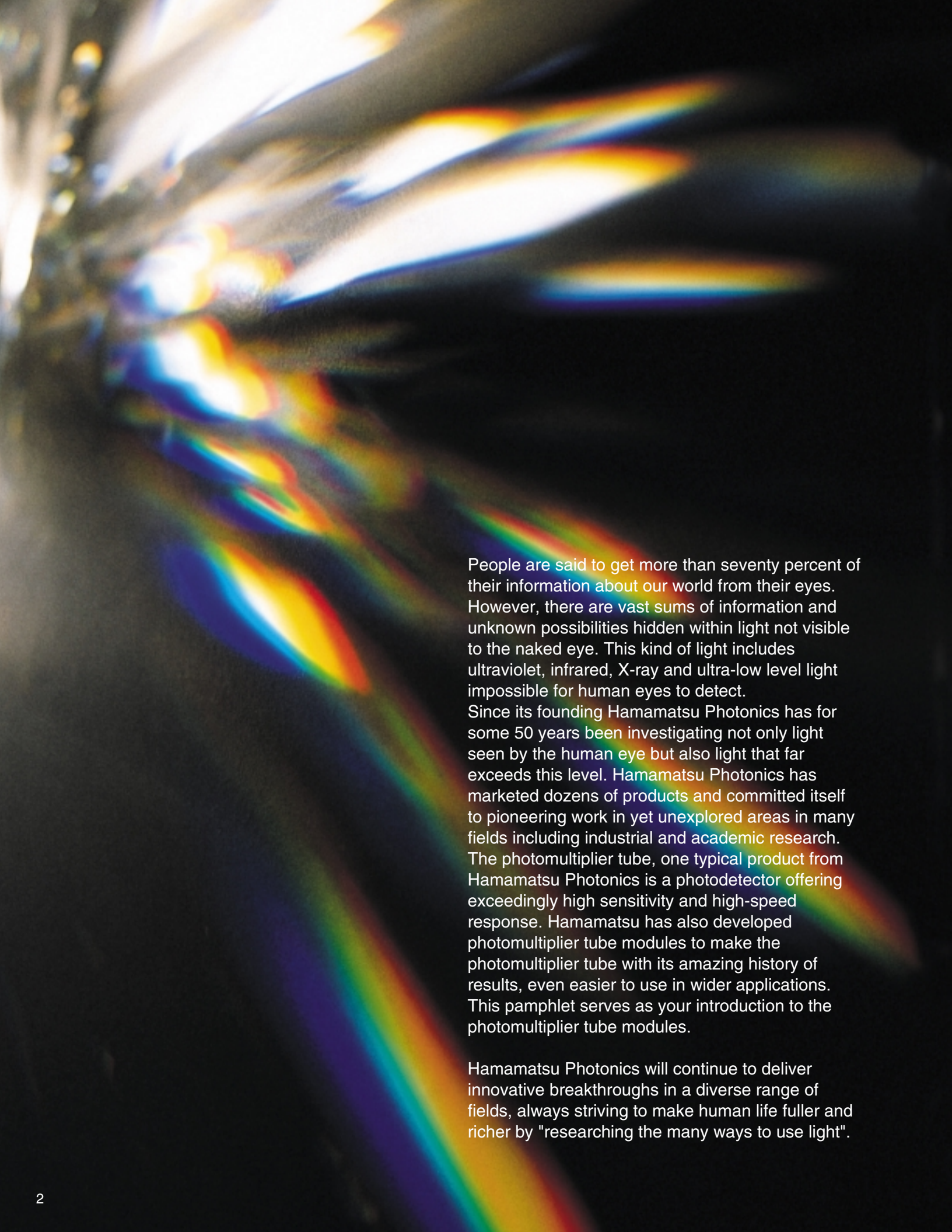
HAMAMATSU



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 for some 50 years 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".

CONTENTS

Product Lineup

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.

PMT Modules

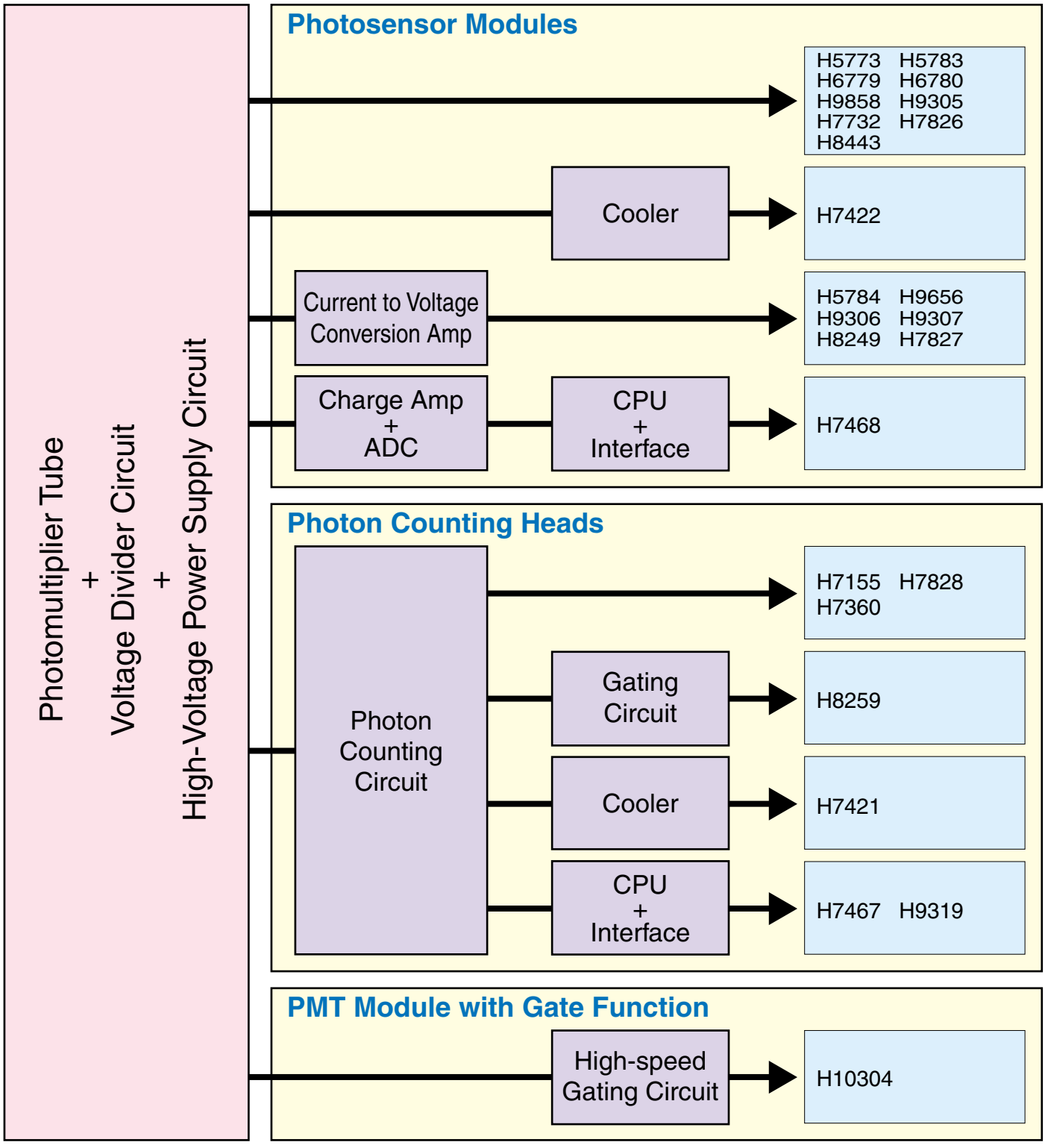
Type	Metal Package Type	Compact Head-on Type	Head-on Type	Compact Side-on Type	Side-on Type
Photosensor Modules **Current Output**	 H5773/H5783 H6779/H6780 H9858	 H7826	 H8443	 H9305	 H7732
With Cooler	 H7422				
Photosensor Modules **Voltage Output**	 H5784/H9656	 H7827		 H9306/H9307	 H8249
Photosensor Module **With Charge Amp+** **ADC+** **CPU+** **Interface**	 H7468				
Photon Counting Heads **Photon Counting**	 H7155	 H7828	 H7360		 H8259
With Cooler	 H7421				
With CPU+ **Interface**	 H7467		 H9319		
PMT Module **With Gate Function**	 H10304				

* Products are applicable to "OPTICAL BLOCKS FOR PMT MODULES" listed on page 68.

Functions

PMT module functions are shown with a chart format below. 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.

PMT Modules



Characteristics

The table below shows characteristic comparison among different PMT modules, allowing you to easily find and compare the measurement wavelength range, time response, photosensitive area size and outer dimensions.

Note: The measurement wavelength is shown as the wavelength range covered by the device series and may differ according to the individual product.
The cubic ratio in the outer dimension column is compared by setting the volume of the H5773/H6779 series as a reference figure of 1.

Photosensor Modules

Type	Type No.	Spectral Response (200 400 600 800 nm)	Rise Time (0 1 2 3 ns)	Photosensitive Area (mm)	Outside Size: Cubic Ratio	Outside Size: Dimensions (mm)	Input Voltage (V)	Remarks
Current Output	H5773 Series H5783 Series	185 to 920	0.78	φ8	1	50 × 25 × 18 22 × 22 × 50	+15	Low power consumption
	H6779 Series H6780 Series	185 to 920	0.78	φ8	1	50 × 25 × 18 22 × 22 × 50	+15	Low ripple noise Fast settling time
	H9858 Series	185 to 920	0.78	φ8	1	50 × 25 × 18	+3	For portable unit Low power consumption
	H7422 Series	300 to 920	0.78 / 1	φ7 / φ5	9.3	56 × 36 × 104	+15	Built-in cooler
	H9305 Series	185 to 900	1.4	3.7 × 13	2.3	19 × 53 × 51	+15	High gain, compact High sensitivity in near IR
	H7732 Series	185 to 900	2.2	4 × 20	8.0	38 × 95 × 50	+15	High gain
	H7826 Series	300 to 850	1.5	φ15	3.2	26 × 50 × 56	+15	For portable unit Easily couples to scintillator
	H8443	300 to 650	1.6	φ22	4.9	φ34 × 121	+15	Wide sensitive area

Photosensor Modules

Type	Type No.	Spectral Response (200 400 600 800 nm)	Frequency Response (DC 100 200 kHz)	Photosensitive Area (mm)	Outside Size: Cubic Ratio	Outside Size: Dimensions (mm)	Input Voltage (V)	Remarks
Voltage Output	H5784 Series	185 to 920	20	φ8	1.3	22 × 22 × 60	+/-15	Feedback resistance 1 MΩ
	H9656 Series	185 to 920	200	φ8	1.4	51 × 24 × 25	+/-15	Feedback resistance 100 kΩ
	H9306 Series	185 to 900	20	3.7 × 13	2.3	19 × 53 × 51	+/-15	Feedback resistance 1 MΩ
	H9307 Series	185 to 900	200	3.7 × 13	2.3	19 × 53 × 51	+/-15	Feedback resistance 100 kΩ
	H8249 Series	185 to 900	20 200	4 × 20	8.0	38 × 95 × 50	+/-15	Feedback resistance 1 MΩ (20 kHz) Feedback resistance 100 kΩ (200 kHz)
	H7827 Series	300 to 850	20 200	φ15	3.2	26 × 50 × 56	+/-15	Feedback resistance 1 MΩ (20 kHz) Feedback resistance 100 kΩ (200 kHz)

Photosensor Module

Type	Type No.	Spectral Response (200 400 600 800 nm)	Characteristics	Photosensitive Area (mm)	Outside Size: Cubic Ratio	Outside Size: Dimensions (mm)	Input Voltage (V)	Remarks
Internal CPU +interface	H7468 Series	185 to 920	Integration Time 40 µs to 500 ms	φ8	4.7	35 × 50 × 60	+5	Charge amp+ADC

Photon Counting Heads

Type	Type No.	Spectral Response (200 400 600 800 nm)	Count Linearity (1 5 10 ×10⁶ s⁻¹)	Photosensitive Area (mm)	Outside Size: Cubic Ratio	Outside Size: Dimensions (mm)	Input Voltage (V)	Remarks
Photon-counting	H7155 Series	300 to 850	1.5 10 (with internal prescaler)	φ8	2.4	22 × 50 × 50	+5	Small size Prescaler type available
	H7421 Series	300 to 890	1.5	φ5	9.3	56 × 36 × 104	+5	Built-in cooler High quantum efficiency
	H8259 Series	185 to 900	2.5	4 × 20 4 × 6 (-02 Type)	8.0	38 × 95 × 50	+5	Visible to near IR Gate function
	H7828 Series	300 to 850	1.5	φ15	3.2	26 × 50 × 56	+5	For portable unit
	H7360 Series	300 to 850	6	φ22	4.6	φ34 × 114	+5	Cylindrical shape Wide sensitive area
	H7467 Series	300 to 850	1.5	φ8	4.7	35 × 50 × 60	+5	Photon counting circuit+ counter+ CPU+interface
	H9319 Series	300 to 850	20 (with internal prescaler)	φ22	5.1	φ35 × 120	+5	Photon counting circuit+ counter+ CPU+interface

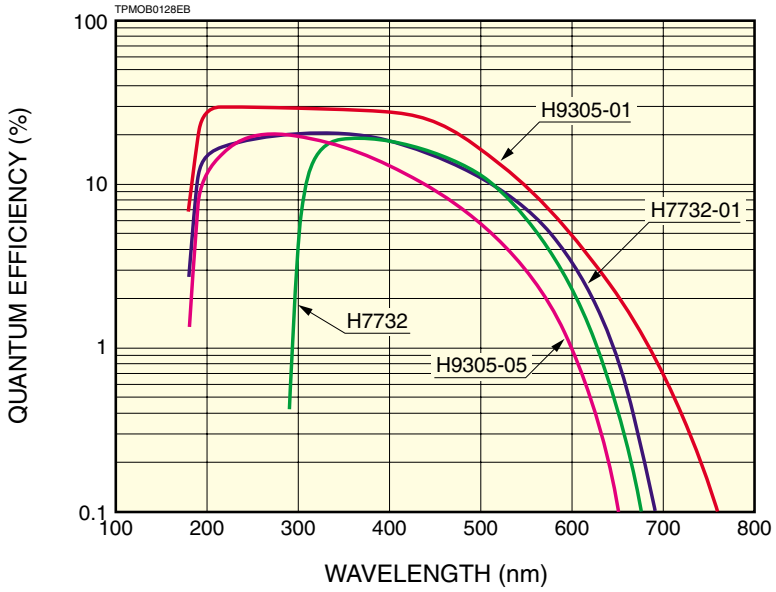
PMT Module

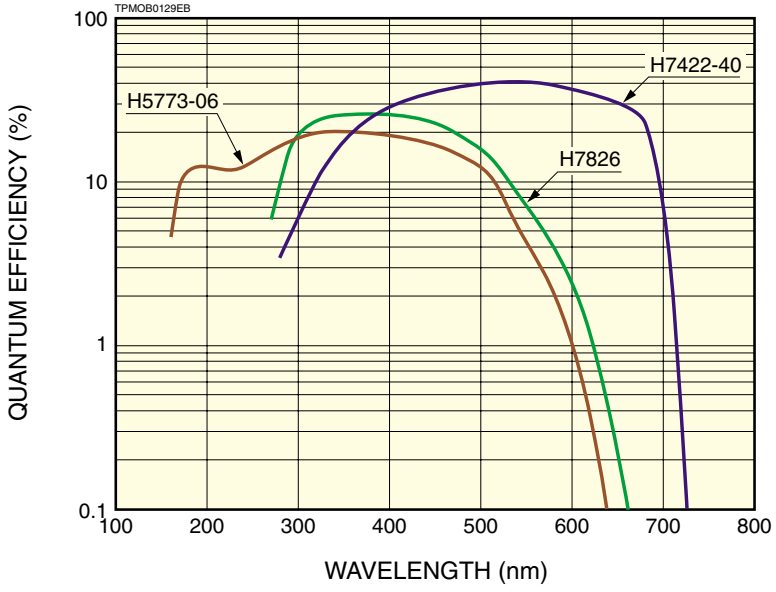
Type	Type No.	Spectral Response (200 400 600 800 nm)	Characteristics	Photosensitive Area (mm)	Outside Size: Cubic Ratio	Outside Size: Dimensions (mm)	Input Voltage (V)	Remarks
With gate function	H10304 Series	185 to 920	0.78	φ8	4.7	35 × 50 × 60	+15	High-speed gate Small size

Spectral Response

The quantum efficiency of the PMT module is compared in the following graphs. Quantum efficiency is the conversion ratio of photoelectrons per photon and is a very important factor that determines the S/N characteristic. It is essential to select a PMT module having high quantum efficiency on the wavelengths of light to be measured. To obtain a lower detection limit with a good S/N ratio in low-light-level measurement, the dark current and dark count must also be considered as well as the quantum efficiency.

Spectral response characteristics example of PMT modules sensitive to UV through visible light are shown in the graphs below.

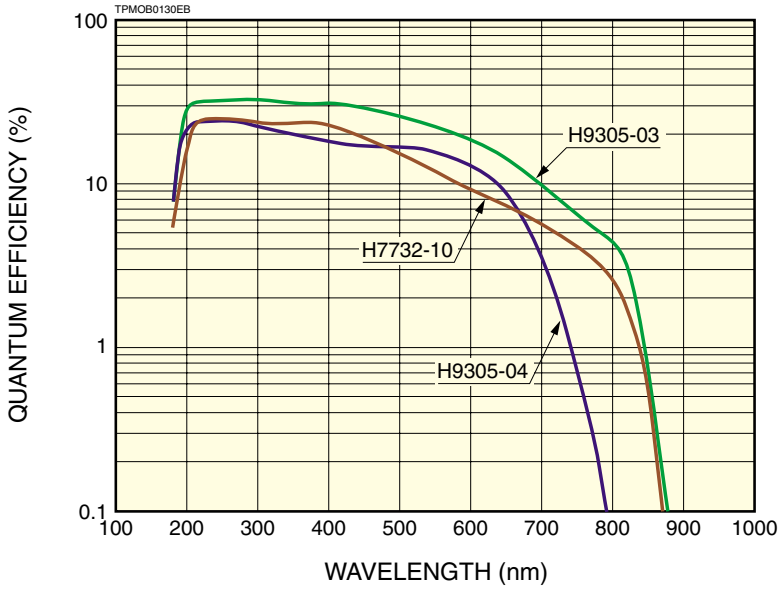


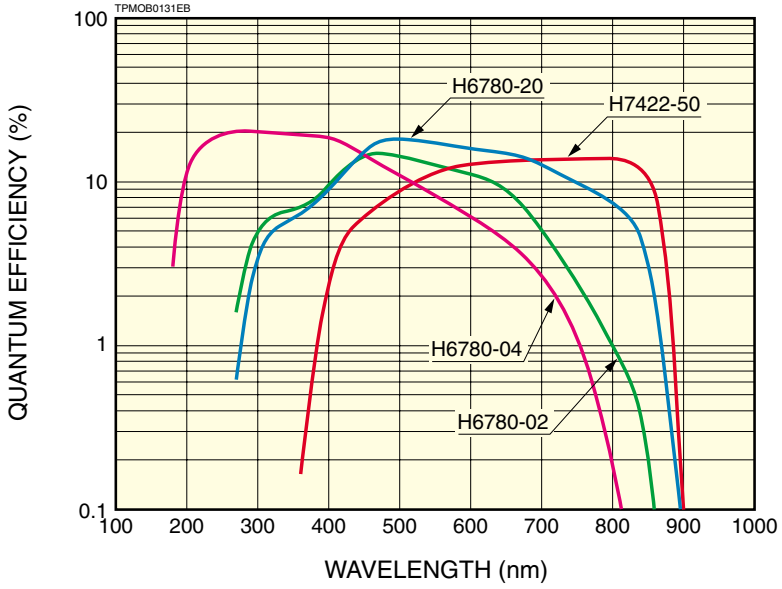


Typical Quantum Efficiency (Unit: %)

Wavelength	H7732	H7732-01	H9305-01	H9305-05	H7826	H5773-06	H7422-40
200 nm	—	14.9	27.3	11.8	—	12.4	—
300 nm	4.1	20.2	28.9	19.5	20.0	18.5	6.0
400 nm	18.6	18.6	27.3	13.0	25.7	18.9	28.2
500 nm	11.6	11.0	16.4	5.8	16.1	12.4	40.0
600 nm	2.2	3.5	5.0	0.9	2.4	1.0	36.1
700 nm	—	0.1	0.7	—	—	—	7.7

Spectral response characteristics example of PMT modules sensitive to UV through near infrared light are shown in the graphs below.

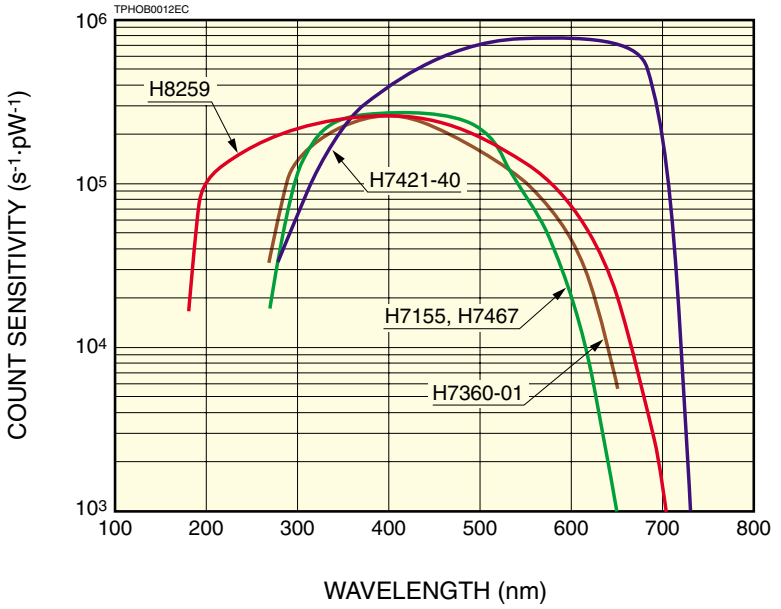


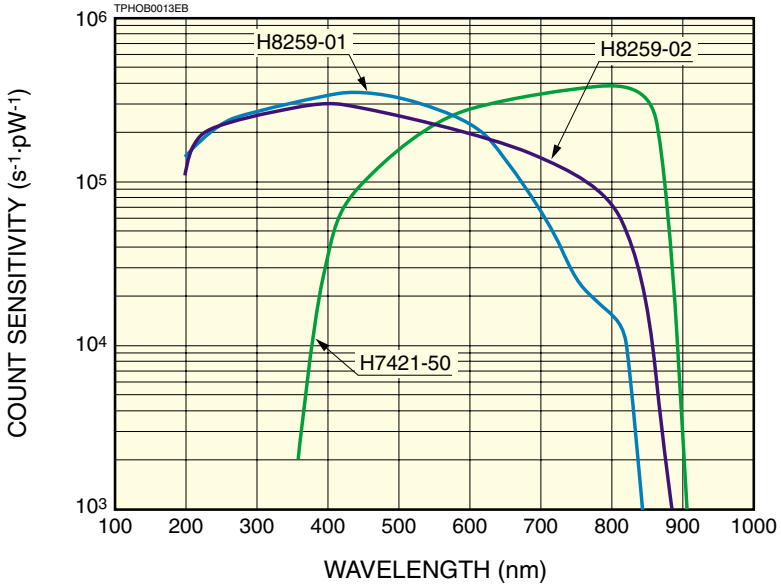


Typical Quantum Efficiency (Unit: %)

Wavelength	H9305-03	H9305-04	H7732-10	H6780-02	H6780-04	H6780-20	H7422-50
200 nm	29.0	21.3	15.8	—	11.5	—	—
300 nm	32.9	22.3	23.8	5.0	20.1	3.4	—
400 nm	31.3	18.3	22.9	9.6	18.6	8.9	2.3
500 nm	25.7	16.6	15.4	14.4	11.0	18.3	8.8
600 nm	18.6	12.9	9.3	11.1	6.1	15.9	12.9
700 nm	9.7	3.5	5.7	5.2	2.6	12.8	13.7
800 nm	4.3	0.1	2.7	1.0	0.2	7.4	13.9

Spectral photon counting sensitivity example of PMT modules are shown in the graphs below.





Typical Photon Counting Sensitivity (Unit: $s^{-1} \cdot pW^{-1}$)

Wavelength	H7155	H7421-50	H7421-40	H7360-01	H8259	H8259-01	H8259-02
200 nm	—	—	—	—	1.1×10^5	1.4×10^5	1.1×10^5
300 nm	1.2×10^5	—	6.3×10^4	1.4×10^5	2.1×10^5	2.7×10^5	2.5×10^5
400 nm	2.7×10^5	3.3×10^4	4.0×10^5	2.7×10^5	2.6×10^5	3.3×10^5	3.0×10^5
500 nm	2.2×10^5	1.6×10^5	7.0×10^5	1.7×10^5	1.9×10^5	3.2×10^5	2.5×10^5
600 nm	2.1×10^4	2.7×10^5	7.6×10^5	4.6×10^4	7.5×10^4	2.3×10^5	2.0×10^5
700 nm	—	3.4×10^5	1.9×10^5	—	1.5×10^3	6.8×10^4	1.4×10^5
800 nm	—	3.9×10^5	—	—	—	1.6×10^4	7.5×10^4
900 nm	—	2.8×10^3	—	—	—	—	3.0×10^2

Constitution Examples

Examples of how to use PMT modules and related products are shown below according to the type of measurement. Power connections to the PMT module and other products are not shown here. Check the product instructions for how to make the power supply connections.

The cable ends of the cable output types (H5783, H9305, H7360 series, etc.) 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 oscilloscopes

Current/Voltage Output Type

Commercial Oscilloscope

Current Output Type

Amplifier Unit (P66)

Commercial Oscilloscope

TPMOC0157EA

Connecting to ammeters

Current Output Type

Commercial Ammeter

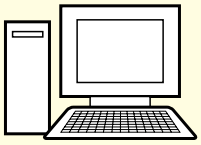
TPMOC0158EA

Using AD converters

Current Output Type

Data Acquisition Unit (P67)

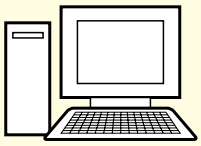
RS-232C



Current Output type

Amplifier Unit (P66)

Commercial ADC Board



Internal Charge Amp + ADC + Interface

RS-232C

TPMOC0159EA

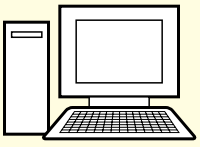
Time-correlated Single photon Counting

Current Output Type

Amplifier Unit (P66)

Commercial CFD

Commercial TAC

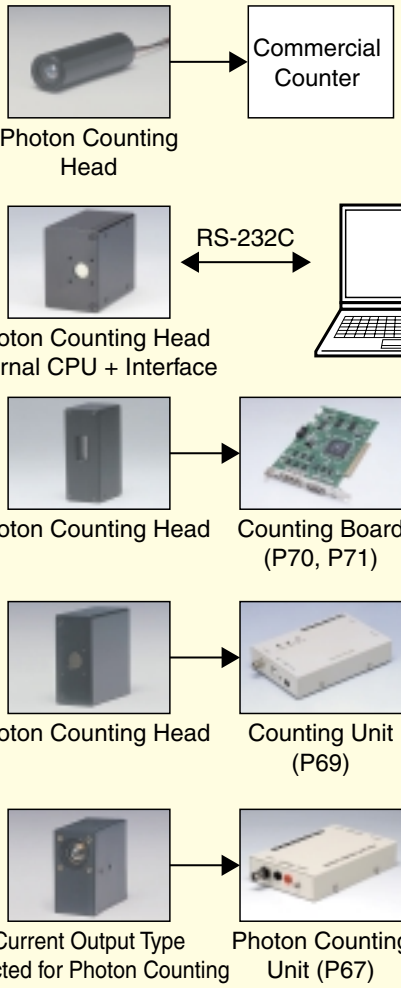


TPMOC0160EA

Fluorescence correlation spectroscopy

TPMOC0161EA

Photon counting

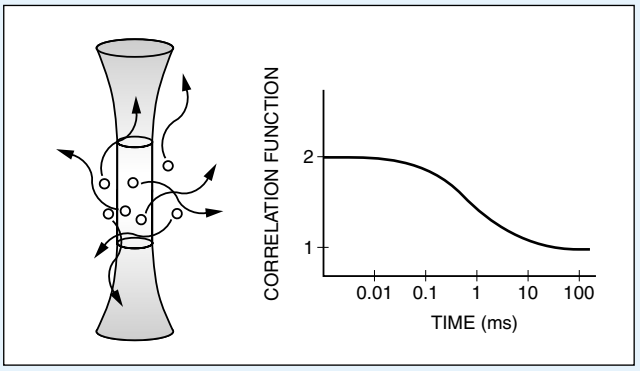


TPHOC0047EB

Application Examples

Fluorescence-correlation Spectroscopy

Advances in laser technology and high performance computers are allowing dramatic progress in research that studies the behavior of single molecules. Fluorescence-correlation spectroscopy is one technique for measuring single molecules. The principle of fluorescence-correlation spectroscopy was conceived in the 1970s, but it wasn't until the 1990s that the proper equipment was around to use it. The equipment structure is largely the same as the confocal laser microscope but there is no Galvano mirror, and only small area of solution is observed. The movement of the fluorescent molecules entering and leaving the area subject to observation and the fluorescent intensity are measured by auto correlation algorithm.



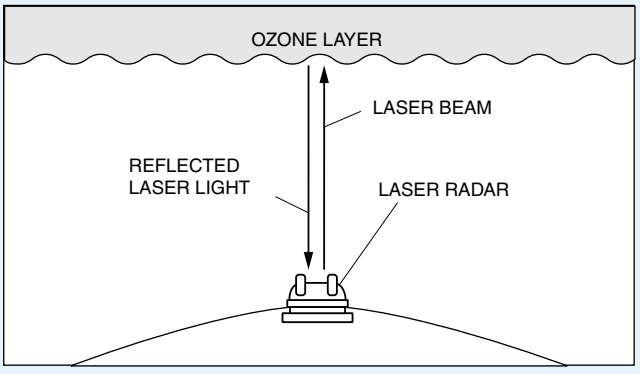
TPMOC0135EB

Vital characteristics
- High quantum efficiency
- Less after pulse

PMT module
- H7421-40 (p. 48)

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 gases, 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_2, SO_2 and NOx concentrations, wind velocity and also the extent of visibility.



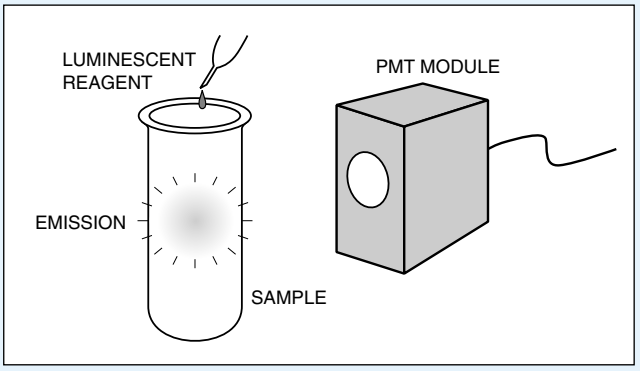
TPMOC0136EA

Vital characteristics
- Gated operation
- Less after pulse

PMT module
- H10304 Series (p. 62)
- H7360-01 (p. 56)

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.



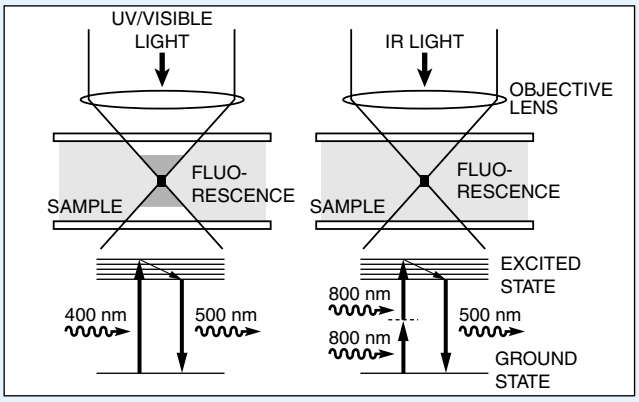
TPMOC0137EA

Vital characteristics
- Compact and light weight
- Low power consumption

PMT module
- H7828 (p. 54)
- H9305 Series (p. 24)

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.



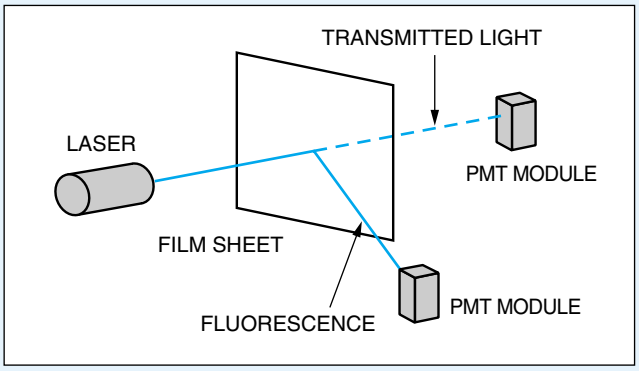
TPMOC0138EA

Vital characteristics
- High quantum efficiency

PMT module
- H7422-40 (P. 20)
- H9305-03 (P. 24)

X-ray Image Readout

Devices used to read X-ray images consist of a method using a brightness storage phosphor plate and a method for directly reading X-ray film. The brightness storage phosphor plate can temporarily store the X-ray information that was detected. The stored information on the plate is scanned by a laser beam and then extracted by measuring the fluorescent intensity with PMT modules. The X-ray film is also scanned by a laser beam in the same way and the transmitted light is detected as an electrical signal, which is then converted into a digital signal. These devices can show the X-ray image on a CRT monitor, store and file the image on a disk, or send the image data over a telephone line.



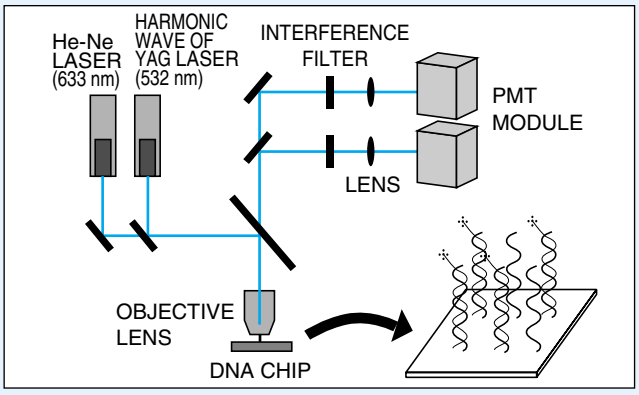
TPMOC0139EA

Vital characteristics
- Wide dynamic range
- High sensitivity

PMT module
- H6780-01 (p. 16)
- H7732 (p. 26)

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.)



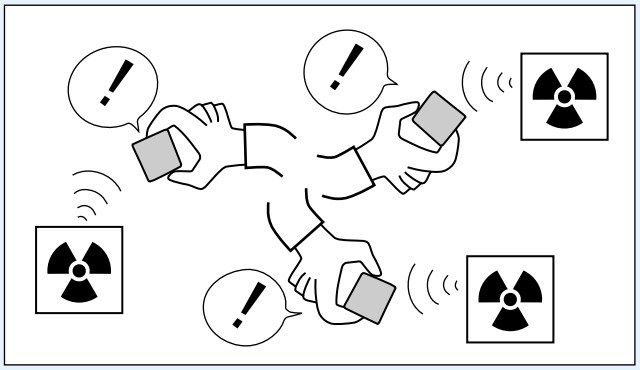
TPMOC0140EA

Vital characteristics
- High quantum efficiency
- High-speed response

PMT module
- H9305 Series (p. 24)

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.



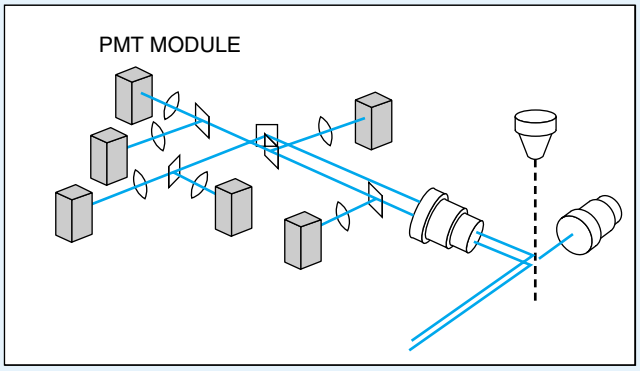
TPMOC0141EA

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

PMT module
- H9858 Series (p. 18)
- H7826 (p. 28)

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.



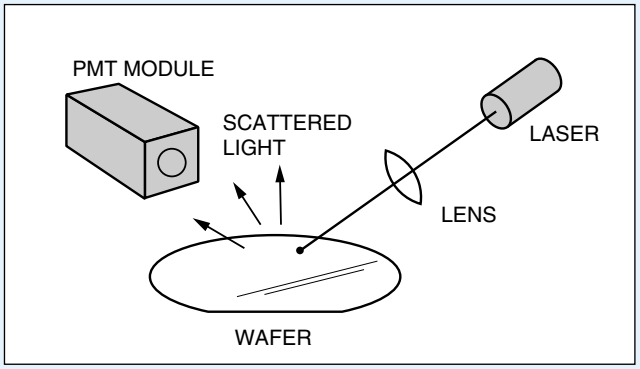
TPMOC0142EB

Vital characteristics
- High-speed response
- High quantum efficiency

PMT module
- H9305 Series (p. 24)
- H6779/H6780 Series (p.16)

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.



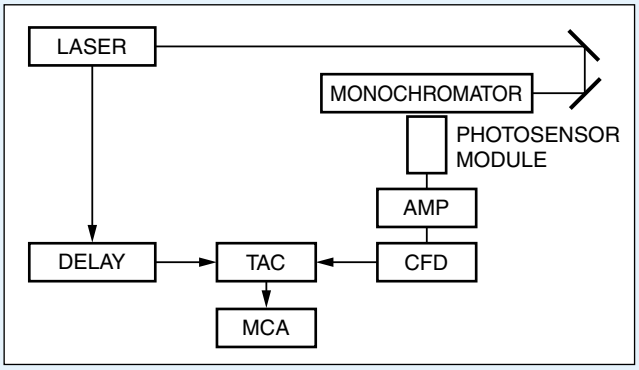
TPMOC0143EA

Vital characteristics
- High-speed response
- Wide dynamic range

PMT module
- H6780-01 (p. 16)

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.



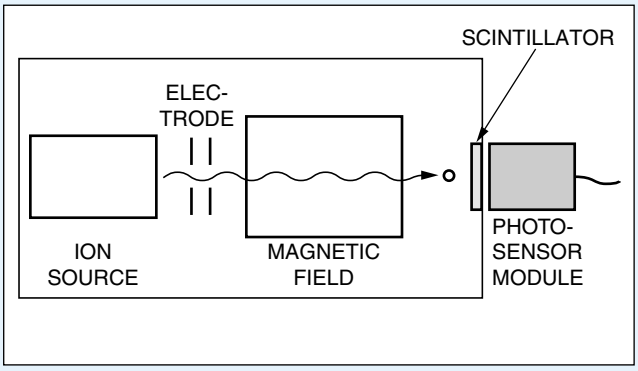
TPMOC0163EA

Vital characteristics
- High-speed response
- High Gain

PMT module
- H5783P (p. 16)
- H7422P Series (p. 20)

Mass Spectroscopy

Mass spectroscopy is an essential measurement technique to analyze samples in various fields such as medicine, pharmacy and environment monitoring. Samples are ionized by vaporization under a high vacuum pressure. The generated ions are accelerated by strong electric fields and sent to a mass analyzer with a strong magnetic field where the ions are separated according to the ratio (m/e) of mass (m) to electron charge (e). Ions with larger molecular weight are detected with a PMT module in conjunction with a scintillator.



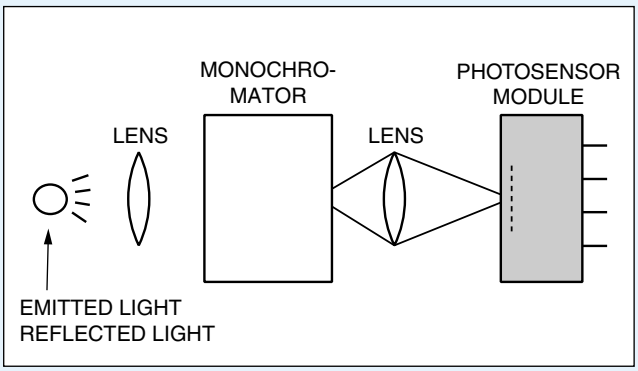
TPMOC0164EA

Vital characteristics
- Wide dynamic range

PMT module
- H5773 (p. 16)

Spectral Radiometers

Spectral radiometers are used to measure spectral distribution, luminance and chromaticity-correlated color temperature of display devices such as LCD and CRT, without making contact with them. Although solid-state photodetectors are commonly used for spectral radiometers, PMT modules enable precision measurement even at low light levels.



TPMOC0165EA

Vital characteristics
- Compact

PMT module
- H5773 Series (p. 16)

Metal Package PMT

Photosensor Modules H5773/H5783/H6779/H6780 Series

The H5773/H5783/H6779/H6780 series are photosensor modules housing a metal package PMT and high-voltage power supply circuit. The metal package PMTs have a metallic package with the same diameter as a TO-8 package used for semiconductor photodetectors, and deliver high gain, wide dynamic range and high-speed response while maintaining small dimensions identical to those of photodiodes. The internal high-voltage power supply circuit is also compact, making the module easy to use.

Considering the mounting methods, a cable output type and a pin output type are provided, and a total of 7 types are available according to the wavelength range to be measured. P-type is also available with selected gain and dark count ideal for photon counting under extremely low light conditions.

Product Variations

Type No. \ Suffix	None	-01	-02	-03	-04	-06	-20	Output Type	Features
H5773	yes	yes	yes	yes	yes	yes	yes	On-board	Low power consumption
H5783	yes	yes	yes	yes	yes	yes	yes	Cable output	
H5773P	yes	no	no	no	no	no	no	On-board	For photon counting
H5783P	yes	no	no	no	no	no	no	Cable output	Low power consumption
H6779	yes	yes	yes	yes	yes	yes	yes	On-board	Low ripple noise
H6780	yes	yes	yes	yes	yes	yes	yes	Cable output	Fast settling time

Suffix	Spectral Response
None	300 nm to 650 nm
-01	300 nm to 850 nm
-02	300 nm to 880 nm
-03	185 nm to 650 nm
-04	185 nm to 850 nm
-06	185 nm to 650 nm
-20	300 nm to 920 nm

The suffix -06 type (synthetic silica window) has higher sensitivity than the -03 type below 300 nm in wavelength range.

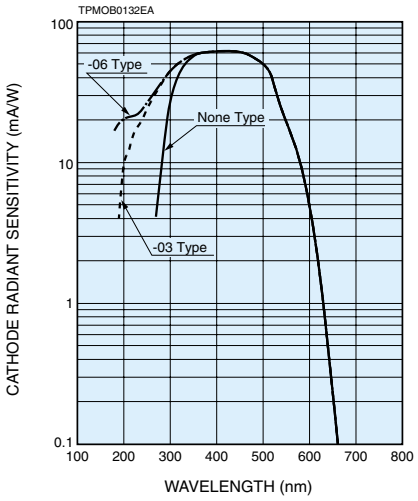
Specifications

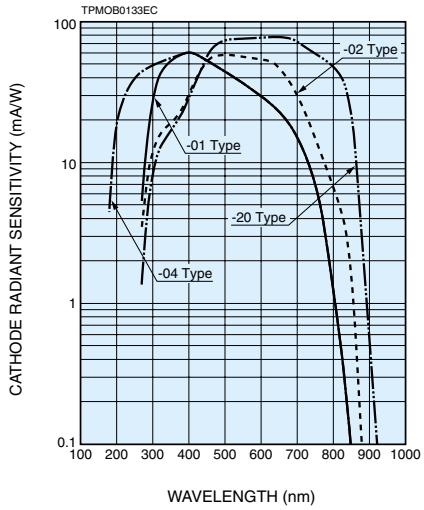
Parameter			H5773 / H5783 / H6779 / H6780 Series					Unit
Suffix			None	-03, -06	-01, -04	-02	-20	—
Input Voltage			+11.5 to +15.5					V
Max. Input Voltage			+18					V
Max. Input Current			H5773 / H5783 Series: 9 H6779 / H6780 Series: 30					mA
Max. Output Signal Current			100					μA
Max. Control Voltage			+1.0 (Input impedance 100 kΩ)					V
Recommended Control Voltage Adjustment Range			+0.25 to +0.9					V
Effective Area			φ8					mm
Sensitivity Adjustment Range			1: 10^4					—
Peak Sensitivity Wavelength			420	420	400	500	630	nm
Cathode	Luminous Sensitivity	Min.	40	40	80	200	350	μA/lm
		Typ.	70	70	150	250	500	
	Blue Sensitivity Index (CS 5-58)	Typ.	8	8	—	—	—	—
	Red/White Ratio	Typ.	—	—	0.2	0.25	0.45	—
	Radiant Sensitivity *1	Typ.	62	62	60	58	78	mA/W
Anode (Standard Type)	Luminous Sensitivity *2	Min.	10	10	15	25	35	A/lm
		Typ.	50	50	75	125	250	
	Radiant Sensitivity *1 *2	Typ.	4.3×10^4	4.3×10^4	3.0×10^4	2.9×10^4	3.9×10^4	A/W
	Dark Current *2 *3	Typ.	0.2	0.2	0.4	2	2	nA
		Max.	2	2	4	20	20	
Anode (P Type)	Gain *2	Min.	7.5×10^5	—				—
		Typ.	1×10^6	—				
	Radiant Sensitivity *1 *2	Typ.	6.2×10^4	—				A/W
	Dark Count *2 *3	Typ.	50	—				s^{-1}
		Max.	100	—				
Rise Time *2		Typ.	0.78					ns

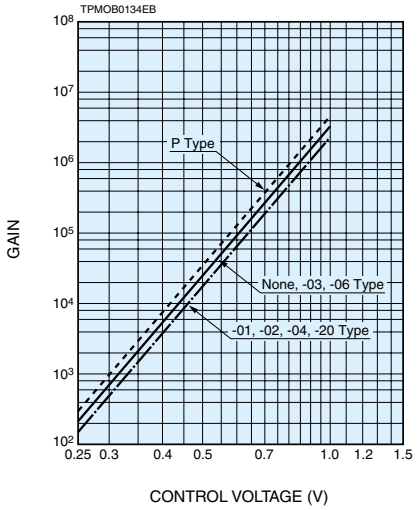
		H5773 Series	H5783 Series	H6779 Series	H6780 Series	
Ripple Noise *2 *4 (peak to peak)	Max.	1.2		0.6		mV
Settling Time *5	Max.	2		0.2		s
Operating Ambient Temperature *6		+5 to +50		+5 to +45		°C
Storage Temperature *6		-20 to +50				°C
Weight		60	80	60	80	g

*1: Measured at the peak sensitivity wavelength *2: Control voltage = +0.8 V *3: After 30 minutes storage in darkness
*4: Cable RG-174/U, Cable length 450 mm, Load resistance = 1 MΩ, Load capacitance = 22 pF
*5: 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. *6: No condensation

Characteristics (Cathode radiant sensitivity, Gain)

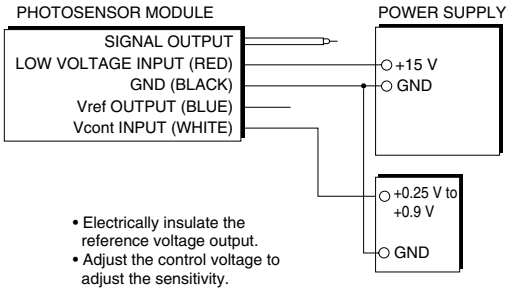






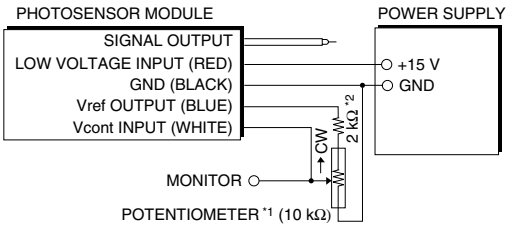
Sensitivity Adjustment Method

VOLTAGE PROGRAMMING



- Electrically insulate the reference voltage output.
- Adjust the control voltage to adjust the sensitivity.

RESISTANCE PROGRAMMING



*1: When using a potentiometer to adjust sensitivity, monitor the control voltage so it does not exceed +1.0 V.
*2: H6799/H6780 series has this 2 kΩ resistor.
No external resistor is needed.

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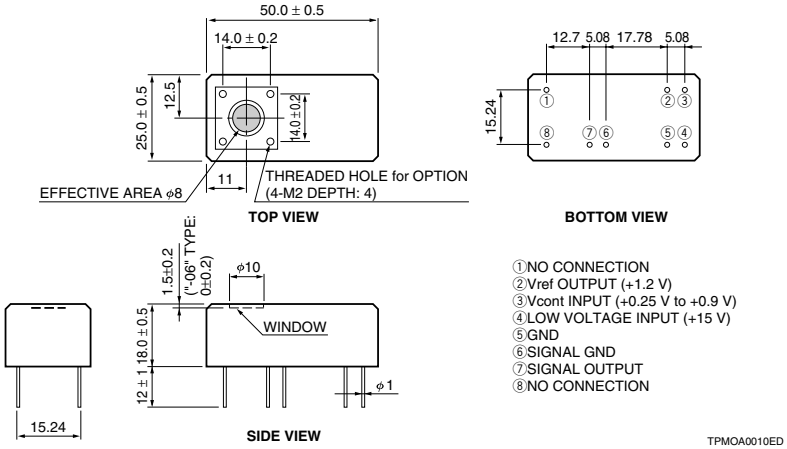
Dimensional Outlines (Unit: mm)

H5773/H6779 Series



①NO CONNECTION
②Vref OUTPUT (+1.2 V)
③Vcont INPUT (+0.25 V to +0.9 V)
④LOW VOLTAGE INPUT (+15 V)
⑤GND
⑥SIGNAL GND
⑦SIGNAL OUTPUT
⑧NO CONNECTION

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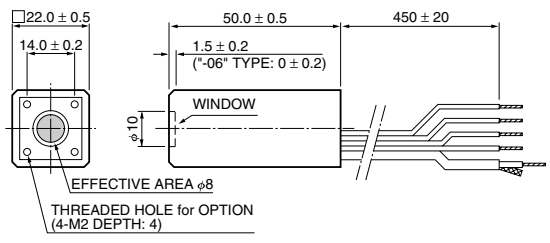
H5783/H6780 Series

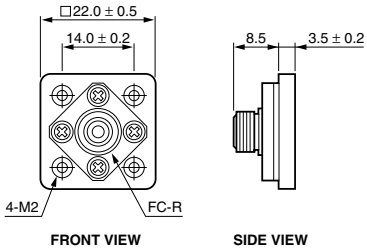


LOW VOLTAGE INPUT (+15 V) : AWG26 (RED)
GND : AWG26 (BLACK)
Vref OUTPUT (+1.2 V) : AWG26 (BLUE)
Vcont INPUT (+0.25 V to +0.9 V) : AWG26 (WHITE)
SIGNAL OUTPUT : RG-174/U

TPMOA0011ED

Options (Optical Fiber Adapter) (Unit: mm)

E5776 (FC Type)



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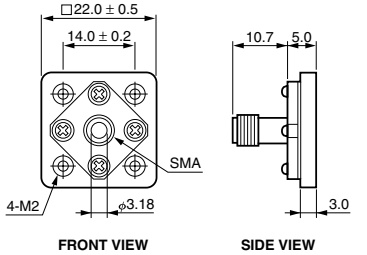
E5776-51 (SMA Type)



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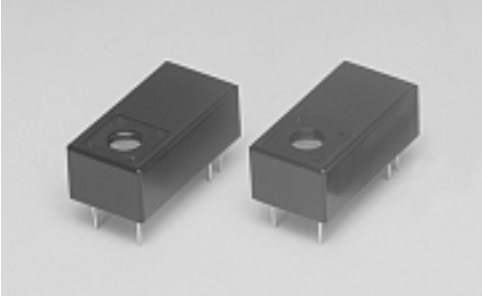
Metal Package PMT

Photosensor Modules H9858 Series



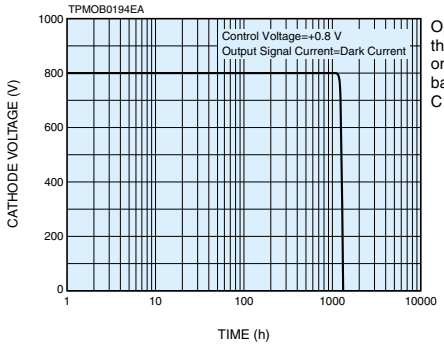
The H9858 series are photosensor modules housing a metal package PMT and high-voltage power supply circuit. The metal package PMTs have a metallic package with the same diameter as a TO-8 package used for semiconductor photodetectors, and deliver high gain, wide dynamic range and high-speed response while maintaining small dimensions identical to those of photodiodes. The internal high-voltage power supply circuit is also compact, making the module easy to use.
A P-type is also available with selected gain and dark count ideal for photon counting under extremely low light conditions.
Compared to the previous types, the power consumption is reduced to 1/15* and the weight to 2/3, making the H9858 series ideal for portable measurement devices.

* Input Voltage=+3.0 V, Control Voltage=+0.8V

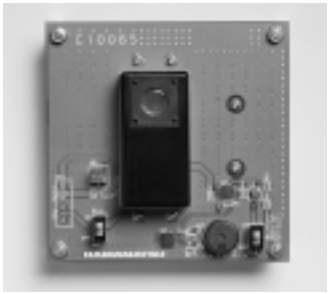
Product Variations

Suffix	Spectral Response
None	300 nm to 650 nm
-01	300 nm to 850 nm
-02	300 nm to 880 nm
-03	185 nm to 650 nm
-04	185 nm to 850 nm
-06	185 nm to 650 nm
-20	300 nm to 920 nm

The suffix -06 type (synthetic silica window) has higher sensitivity than the -03 type below 300 nm in wavelength range.



Operates for more than 1000 hours on two AA alkaline batteries with C10065 (option).



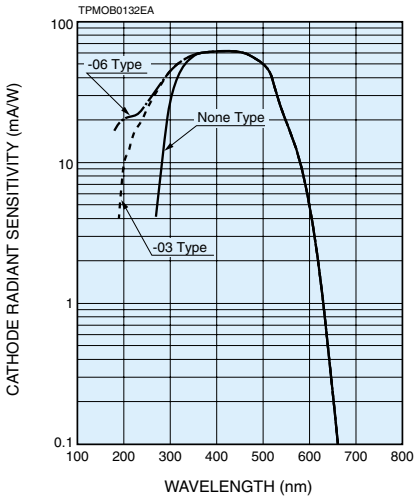
Evaluation board C10065

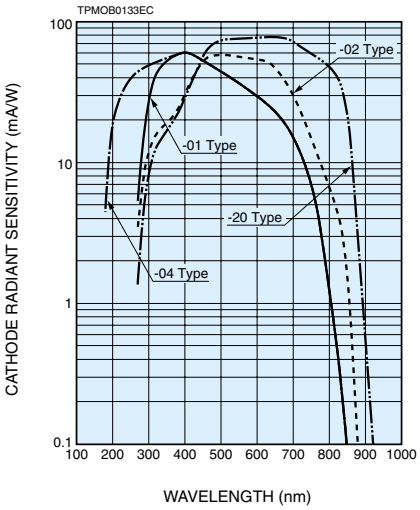
Specifications

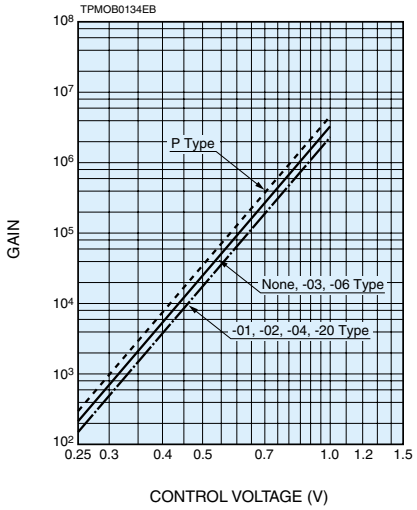
Parameter			H9858 Series					Unit
Suffix			None	-03, -06	-01, -04	-02	-20	—
Input Voltage *1			+2.0 to +5.0					V
Max. Input Voltage			+5.5					V
Max. Input Current *2			2.7					mA
Max. Output Signal Current *3 *4			100					μA
Max. Control Voltage			+1.0 (Input impedance 1 MΩ)					V
Recommended Control Voltage Adjustment Range			+0.25 to +0.9					V
Effective Area			φ8					mm
Sensitivity Adjustment Range			1: 10^4					—
Peak Sensitivity Wavelength			420	420	400	500	630	nm
Cathode	Luminous Sensitivity	Min.	40	40	80	200	350	μA/lm
		Typ.	70	70	150	250	500	
	Blue Sensitivity Index (CS 5-58)	Typ.	8	8	—	—	—	—
	Red/White Ratio	Typ.	—	—	0.2	0.25	0.45	—
	Radiant Sensitivity *5	Typ.	62	62	60	58	78	mA/W
Anode Standard Type	Luminous Sensitivity *3	Min.	10	10	15	25	35	A/lm
		Typ.	50	50	75	125	250	
	Radiant Sensitivity *3 *5	Typ.	4.3×10^4	4.3×10^4	3.0×10^4	2.9×10^4	3.9×10^4	A/W
	Dark Current *3 *6	Typ.	0.2	0.2	0.4	2	2	nA
		Max.	2	2	4	20	20	
Anode P Type	Gain *3	Min.	7.5×10^5	—				—
		Typ.	1×10^6	—				
	Radiant Sensitivity *3 *5	Typ.	6.2×10^4	—				A/W
	Dark Count *3 *6	Typ.	50	—				s^{-1}
		Max.	100	—				
Rise Time *3		Typ.	0.78					ns
Ripple Noise *3 *7 (peak to peak)		Max.	0.6					mV
Settling Time *8		Max.	10					s
Operating Ambient Temperature *9			+5 to +50					°C
Storage Temperature *9			-20 to +50					°C
Weight			45					g

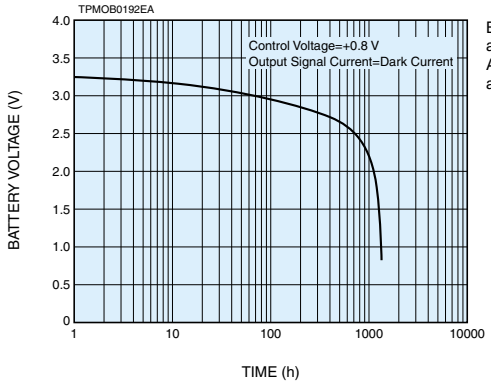
*1: At output current = 1 μA. We recommend setting the input voltage to 2.5 V or more when output current is 10 μA or more.
*2: Input voltage = +3.0 V, Control voltage = +0.8 V, Output signal current = Dark current *3: Control voltage = +0.8 V
*4: Input voltage > +2.1 V *5: Measured at the peak sensitivity wavelength *6: After 30 minutes storage in darkness
*7: Cable RG-174/U, Cable length 450 mm, Load resistance = 1 MΩ, Load capacitance = 22 pF
*8: 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. *9: No condensation

Characteristics (Cathode radiant sensitivity, Gain, Battery operation, Operation at 10 μA output)

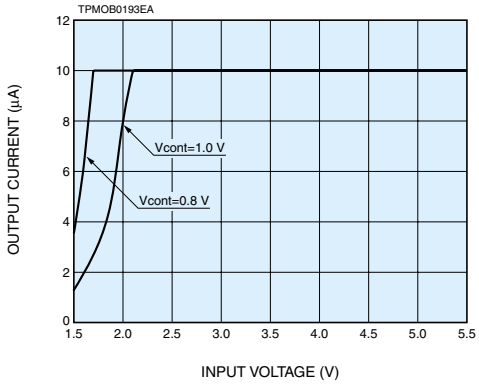






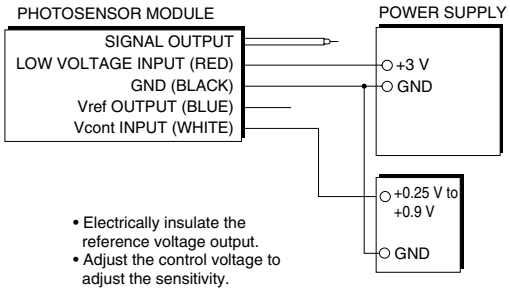


Batteriy voltage characteristics when two AA alkaline batteries are used.



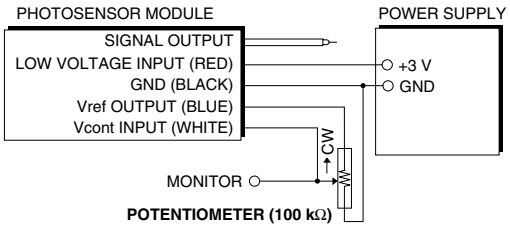
Sensitivity Adjustment Method

VOLTAGE PROGRAMMING



- Electrically insulate the reference voltage output.
- Adjust the control voltage to adjust the sensitivity.

RESISTANCE PROGRAMMING



When using a potentiometer to adjust sensitivity, monitor the control voltage so it does not exceed +1.0 V.

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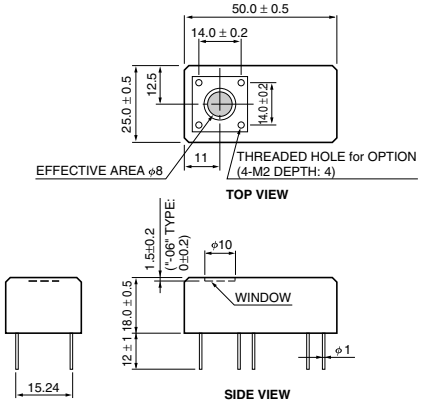
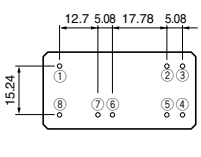
Dimensional Outlines (Unit: mm)



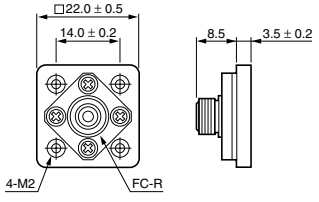


①NO CONNECTION
②Vref OUTPUT (+1.2 V)
③Vcont INPUT (+0.25 V to +0.9 V)
④LOW VOLTAGE INPUT (+3 V)
⑤GND
⑥SIGNAL GND
⑦SIGNAL OUTPUT
⑧NO CONNECTION

TPMOA0039EA

Options (Optical Fiber Adapter) (Unit: mm)

E5776 (FC Type)



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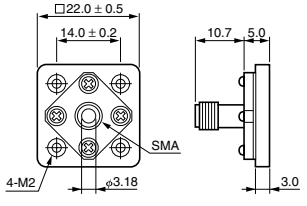
E5776-51 (SMA Type)



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Metal Package PMT with Cooler

Photosensor Modules H7422 Series

Heatsink with fan (A7423) sold separately

The H7422 series are photosensor modules with an internal high-voltage power supply circuit and a cooler installed to the metal package photomultiplier tube. Efficient cooling was achieved by placing the cooler near the photomultiplier tube to reduce thermal noise emitted from the photocathode and a high S/N ratio can be obtained even at extremely low light levels.
The H7422-40 has high sensitivity in the 300 nm to 720 nm wavelengths. The H7422-50 is sensitive along a wide spectral range from 380 nm to 890 nm. The H7422-01, H7422-02 and H7422-20 have a maximum output current value of 100 μA and so are extremely effective when measurements are needed over a wide dynamic range. The photomultiplier tube is maintained at a constant temperature by monitoring the output from a thermistor installed near the photomultiplier and then regulating the current to the thermoelectric cooler.

Product Variations

Type No.	Spectral Response	Max. Output Signal Current	Features	
H7422-40	300 nm to 720 nm	2 μA	GaAsP photocathode, QE 40 % at peak wavelength, high gain (P type)	
H7422P-40				For photon counting
H7422-50	380 nm to 890 nm		GaAs photocathode, QE 12 % at peak wavelength, high gain (P type)	
H7422P-50				For photon counting
H7422-01	300 nm to 850 nm	100 μA	Multialkali photocathode	
H7422-02	300 nm to 870 nm		Infrared-extended multialkali photocathode	
H7422-20	300 nm to 920 nm		Infrared-extended high-sensitivity multialkali photocathode	

Specifications

Parameter				H7422 Series					Unit
Suffix				-40	-50	-01	-02	-20	—
Input Voltage				+11.5 to +15.5					V
Max. Input Voltage for Main Unit				+18					V
Max. Input Current for Main Unit				62		30			mA
Max. Input Voltage for Thermoelectric Cooler				2.6					V
Max. Input Current for Thermoelectric Cooler				2.2					A
Max. Output Signal Current				2		100			μA
Max. Control Voltage				+0.9 (Input impedance 100 kΩ)					V
Recommended Control Voltage Adjustment Range				+0.5 to +0.8		+0.25 to +0.8			V
Effective Area				φ5		φ7			mm
Sensitivity Adjustment Range				1: 50		1: 10^4			—
Peak Sensitivity Wavelength				580	800	400	500	630	nm
Cathode	Radiant Sensitivity	Typ.	420 nm	108	15	56	40	40	mA/W
			550 nm	176	50	36	56	72	
			800 nm	—	90	1.2	6.4	46	
Anode	Standard Type	Radiant Sensitivity *1 Typ.	550 nm	8.8×10^4	2.5×10^4	1.8×10^4	2.8×10^4	3.6×10^4	A/W
		Dark Current *1 *2	Typ.	0.4	0.5	0.03	0.08	0.1	nA
			Max.	1.0	1.3	0.08	0.2	0.25	
	P Type	Radiant Sensitivity *3 Typ.	550 nm	1.8×10^5	5.0×10^4	—	—	—	A/W
		Dark Count *2 *3	Typ.	100	125	—	—	—	s^{-1}
			Max.	300	375	—	—	—	
Rise Time *1			Typ.	1.00		0.78			ns
Ripple Noise *1 *4 (peak to peak)			Max.	0.6					mV
Settling Time *5			Typ.	0.2					s
Operating Ambient Temperature *6				+5 to +35					°C
Storage Temperature *6				-20 to +50					°C
Weight				Approx. 400					g

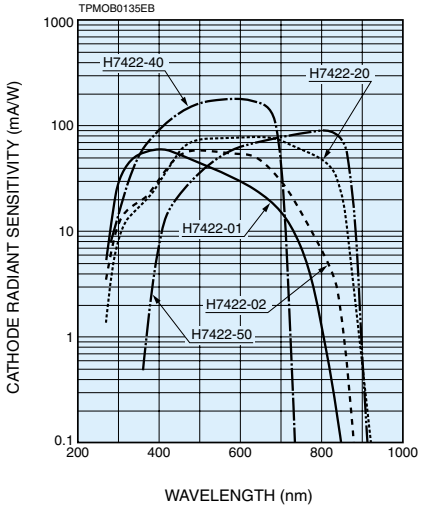
*1: Control voltage = +0.8 V PMT setting temperature 0 °C, used with C8137-02 and A7432 *2: After 30 minutes storage in darkness
*3: Plateau voltage = control voltage, PMT setting temperature 0 °C, used with C8137-02 and A7423
*4: Cable RG-174/U, Cable length 450 mm, Load resistance = 1 MΩ, Load capacitance = 22 pF
*5: 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. *6: No condensation

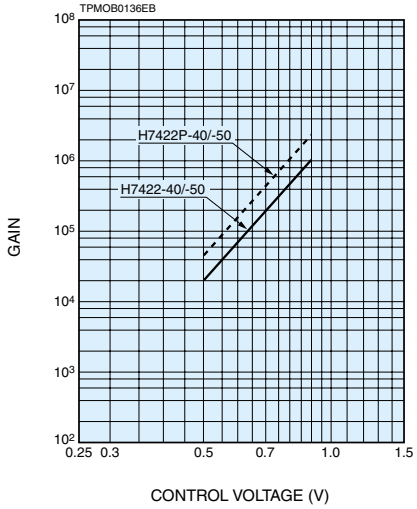
Cooling Specifications

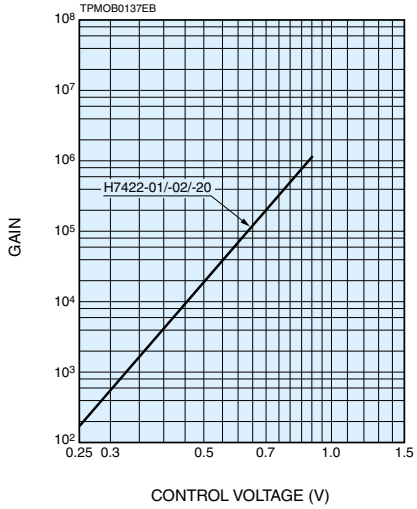
Parameter	H7422 / H7422P Series	Unit
Cooling Method	Thermoelectric cooling	—
Max. Cooling Temperature (ΔT) *7	35	°C
Cooling Time *7	Approx. 5	min

*7: Input current to thermoelectric cooler=2 A

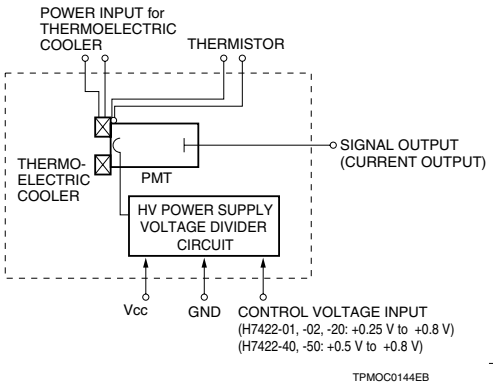
Characteristics (Cathode radiant sensitivity, Gain)





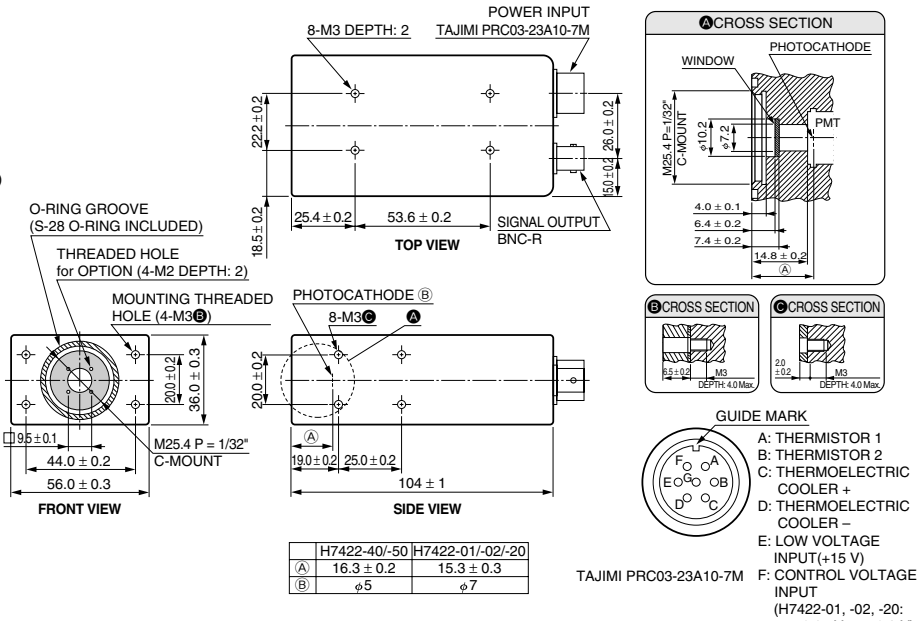


Block Diagram



In order to protect the PMT module from being damaged by excessive light, the H7422-40/50 has a protective function circuit. The circuit automatically turns off high voltage if the output current exceeds the preset current limit (approx. 10 μA). This protection circuit works whenever the preset current limit is exceeded, even for a short moment. An example of this function could be in applications such as laser scanning microscopes where the output current may momentarily exceed the preset current limit. This will trigger the protection circuit and interrupt measurement. In such applications, if the average output current is lower than the PMT module maximum rating (2 μA), we can change the current limit in the protection circuit up to approximately 50 μA. This means that PMT module operation continues without turning off high voltage even if a momentary high output occurs. Users can choose this option when ordering.

Dimensional Outlines (Unit: mm)



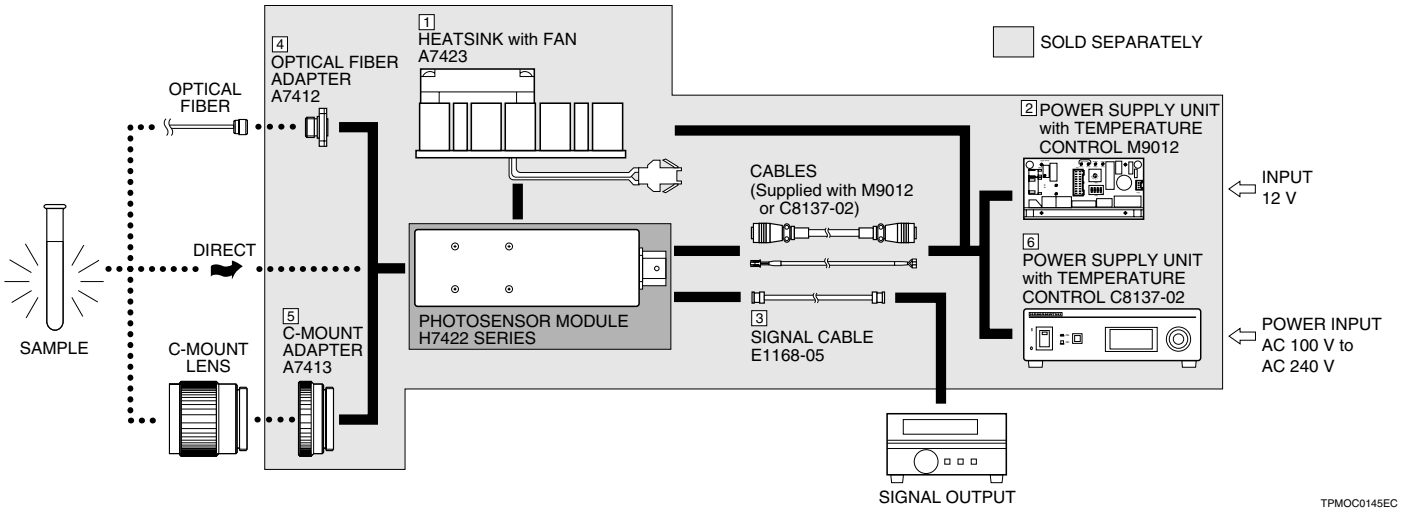
	H7422-40/-50	H7422-01/-02/-20
Ⓐ	16.3 ± 0.2	15.3 ± 0.3
Ⓑ	ϕ5	ϕ7

TAJIMI PRC03-23A10-7M

A: THERMISTOR 1
B: THERMISTOR 2
C: THERMOELECTRIC COOLER +
D: THERMOELECTRIC COOLER –
E: LOW VOLTAGE INPUT(+15 V)
F: CONTROL VOLTAGE INPUT
(H7422-01, -02, -20: +0.25 V to +0.8 V)
(H7422-40, -50: +0.5 V to +0.8 V)
G: GND

TPMOA0024ED

H7422 Series Option



● Heatsink with Fan A7423

The temperature of the H7422 outer case rises due to the thermoelectric cooler housed in the case. The A7423 heatsink efficiently radiates away this heat to prevent a temperature rise in the H7422. The A7423 can be easily installed onto the H7422 with four M3 screws. Apply a heat conductive grease onto the joint surface shared by the H7422 and A7423.

Parameter		Value	Unit
Input Voltage		12	V
Input Current	During Lock	140	mA
	During Operation	90	mA
Operating Voltage		10.2 to 13.8	V
Weight		120	g

● Power Supply Unit with Temperature Control M9012

The M9012 is an on-board type power supply unit.
By just connecting to 12 V supply, the M9012 provides power necessary to operate the H7422 series. The M9012 also controls the thermoelectric cooler in the H7422 series so that the output and noise can be maintained at constant levels even when the ambient temperature changes. The thermoelectric cooler and PMT operation can be controlled from an external device by connecting it to the I/O connector on the M9012.

Parameter		Description / Value	Unit
Max. Cooling Temperature (ΔT)		35	°C
Input Voltage		12	V
Max. Input Current		1.2	A
Max. Power Consumption		15.8	V·A
Main Circuit Output Voltage		12	V
Max. Output Current for Thermoelectric Cooler		2.2	A
Output Voltage for Fan		12	V
Max. Control Output Voltage		1.26	V
Max. Control Input Voltage		0.9	V
Control Signal Input Voltage	Thermoelectric Cooler	Non-insulated TTL level input	—
	PMT	Non-insulated TTL level input	
	Fan	Non-insulated TTL level input	
Error Signal Output Voltage	Thermoelectric Cooler	Non-insulated TTL level output	—
	PMT	Non-insulated TTL level output	
LED Output	PMT	5	V
	Error	5	
Setting Cooling Temperature		0	°C
Weight (excluding cables)		120	g

● Signal Cable E1168-05

This signal cable is terminated with a BNC connector for easily connecting the H7422 to external equipment.

● Optical Fiber Adapter (FC Type) A7412

The A7412 is an FC type optical fiber connector that attaches to the light input window of the H7422. The A7412 can easily be secured in place with four M2 screws.

● C-mount Adapter A7413

The A7413 mount adapter is used when a C-mount lens protruding 4 mm or more from the flange-back must be installed onto the H7422.

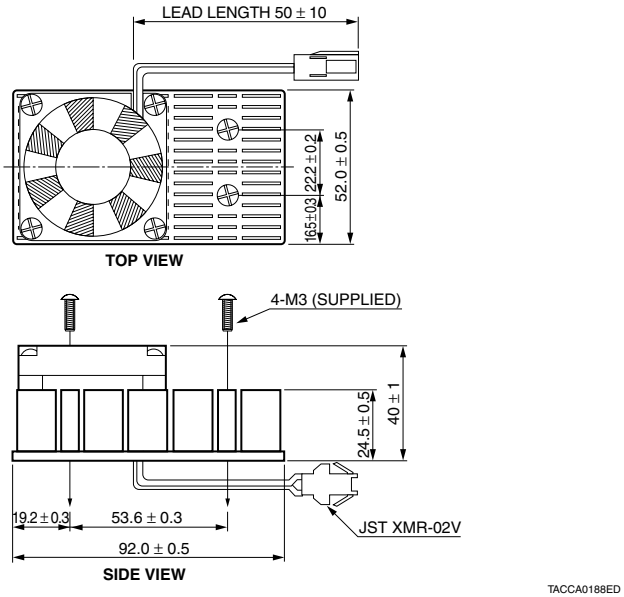
● Power Supply Unit with Temperature Control C8137-02

The C8137-02 is a power supply unit with a temperature control function. Just connecting to an AC source of 100 V to 240 V generates the output voltages for the thermoelectric cooler and the A7423 fan, needed for operating the H7422. The photomultiplier tube temperature can be maintained to 0 °C by monitoring the thermistor and regulating the output current for the thermoelectric cooler. Control voltage can be varied by a knob on the front panel.

Parameter	Value	Unit
Max. Cooling Temperature (ΔT)	35	°C
Setting Cooling Temperature (preset at factory)	0	°C
AC Input Voltage	100 to 240	V
Input Voltage Frequency	50/60	Hz
Power Consumption	30	V·A
Main Circuit Output Voltage	+15	V
Max. Current for Thermoelectric Cooler	2.2	A
Output Voltage for Fan	12	V
Control Voltage Adjustment Range	0 to +0.9	V
Weight	1.1	kg

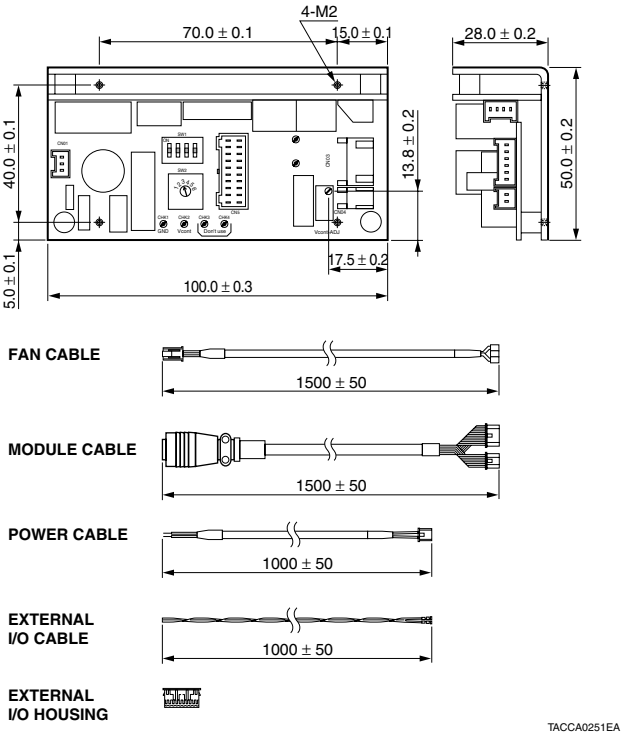
Options (Unit: mm)

1 Heatsink with Fan A7423



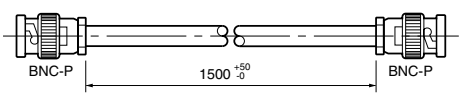
TACCA0188ED

2 Power Supply Unit with Temperature Control M9012



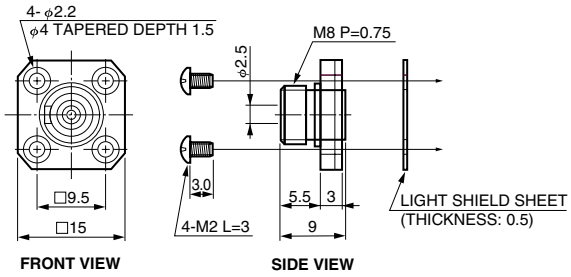
TACCA0251EA

3 Signal Cable E1168-05



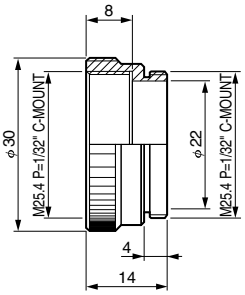
TACCA0148EA

4 Optical Fiber Adapter (FC Type) A7412



TACCA0190EB

5 C-mount Adapter A7413



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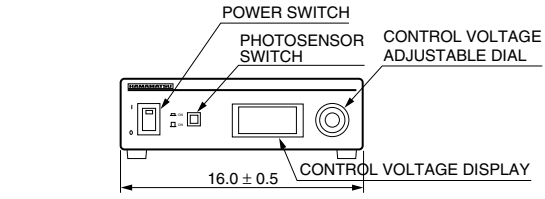
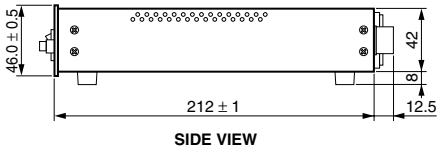
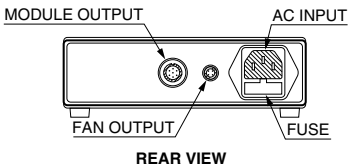
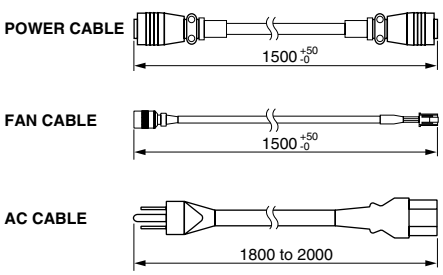
6 Power Supply Unit with Temperature Control C8137-02









TACCA0238EB

Compact Side-on PMT

Photosensor Modules H9305 Series

The H9305 series photosensor modules contain a high-voltage power supply circuit and a 13-mm (1/2") diameter side-on photomultiplier tube in a compact aluminum housing. The 13-mm (1/2") side-on photomultiplier tube has a reflection mode photocathode that delivers high quantum efficiency at wavelengths above 600 nm, an adequate gain of up to 10^7 and fast time response. High S/N ratio can be obtained even when measuring extremely low level light at high speeds.
The H9305 series uses a Cockcroft-Walton circuit with low power consumption. Five types of photomultiplier tubes are provided as standard lineups to meet various needs for spectral response range. Flexible cables are used for easy installation in equipment.

Product Variations

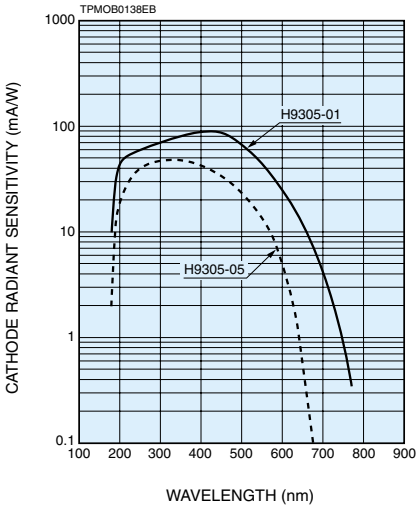
Type No.	Spectral Response	Features
H9305-01	185 nm to 750 nm	High sensitivity in UV to visible range
H9305-02	185 nm to 900 nm	For general applications in UV to near IR range
H9305-03	185 nm to 900 nm	High sensitivity in UV to near IR range
H9305-04	185 nm to 830 nm	Low dark current in UV to near IR range
H9305-05	185 nm to 650 nm	For general applications in UV to visible range

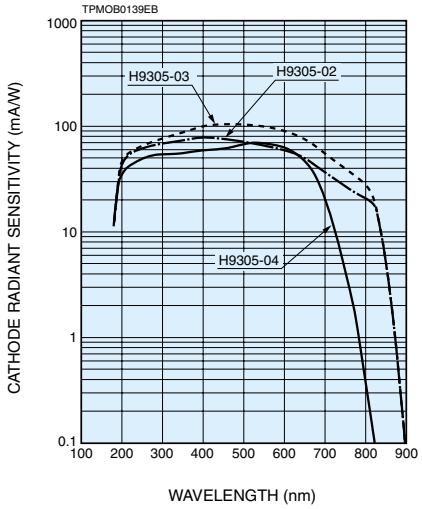
Specifications

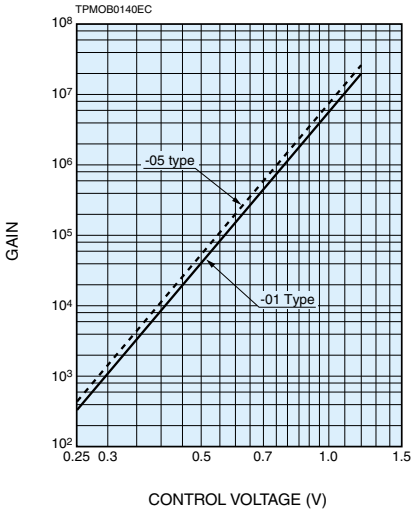
Parameter			H9305 Series					Unit
Suffix			-01	-02	-03	-04	-05	—
Input Voltage			+11.5 to +15.5					V
Max. Input Voltage			+18					V
Max. Input Current			7					mA
Max. Output Signal Current			10					μA
Max. Control Voltage			+1.2 (Input impedance: 1 MΩ)					V
Recommended Control Voltage Adjustment Range			+0.25 to +1.0					V
Effective Area			3.7 × 13.0					mm
Sensitivity Adjustment Range			1: 10^4					—
Peak Sensitivity Wavelength			420	400	450	530	340	nm
Cathode	Luminous Sensitivity	Min.	80	200	350	140	20	μA/lm
		Typ.	120	300	500	200	40	
	Blue Sensitivity Index (CS 5-58)	Typ.	10	—	—	—	5	—
	Red/White Ratio	Typ.	—	0.3	0.4	0.15	—	—
	Radiant Sensitivity *1	Typ.	90	77	105	70	48	mA/W
Anode	Luminous Sensitivity *2	Min.	100	400	1000	300	50	A/lm
		Typ.	700	2000	2000	700	300	
	Radiant Sensitivity *1 *2	Typ.	5.2×10^5	5.2×10^5	4.2×10^5	2.5×10^5	3.6×10^5	A/W
	Dark Current *2 *3	Typ.	1	1	2	0.1	0.5	nA
		Max.	10	10	10	1	5	
Rise Time *2		Typ.	1.4					ns
Ripple Noise *2 *4 (peak to peak)		Max.	0.5					mV
Settling Time *5		Max.	10					s
Operating Ambient Temperature *6			+5 to +50					°C
Storage Temperature *6			-20 to +50					°C
Weight			110					g

*1: Measured at the peak sensitivity wavelength *2: Control voltage = +1.0 V *3: After 30 minutes storage in darkness
*4: Cable RG-174/U, Cable length 450 mm, Load resistance = 1 MΩ, Load capacitance = 22 pF
*5: 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. *6: No condensation

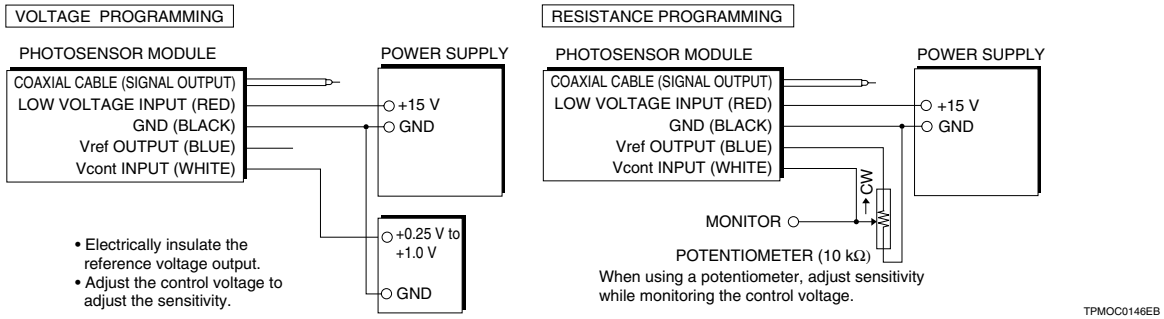
Characteristics (Cathode radiant sensitivity, PMT gain)



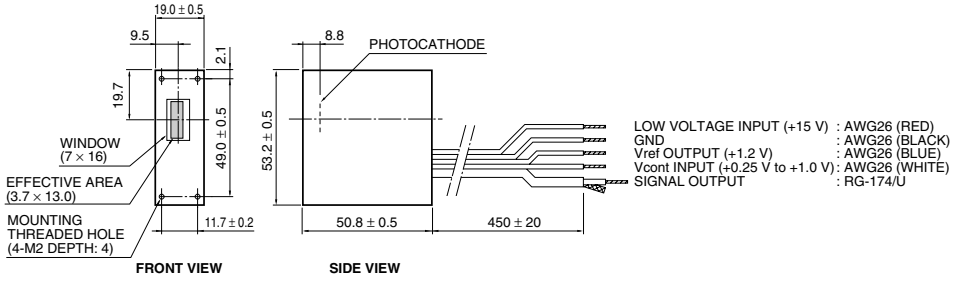




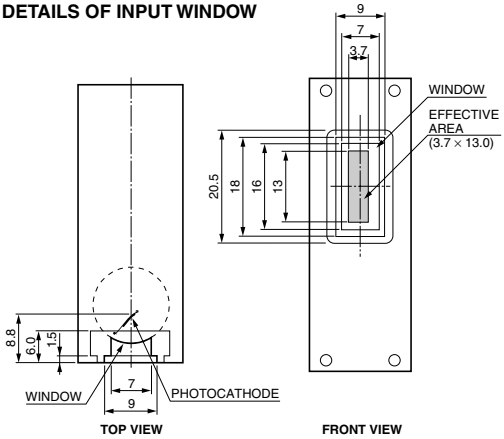
Sensitivity Adjustment Method



Dimensional Outlines (Unit: mm)



DETAILS OF INPUT WINDOW



Side-on PMT

Photosensor Modules H7732 Series

The H7732 series photosensor modules consist of a 28-mm (1-1/8") diameter side-on photomultiplier tube and a high-voltage power supply. These side-on photomultiplier tubes have long been used for spectroscopic applications and provide high gain and high sensitivity. Five types of photomultiplier tubes are provided as standard lineups to meet various needs for spectral response range. Connectors are used for power input and signal output. By selecting cables in convenient length, the H7732 can be easily installed inside equipment or removed from equipment.

The H7732 is a general-purpose type and the H7732-01 is a low-noise type. The H7732-10 is sensitive over a wide range from UV to near infrared and has particularly high sensitivity in wavelengths above 600 nm. The H7732P-01 and H7732P-11 are selected as low dark count types ideal for photon counting and low-light-level measurement.

Product Variations

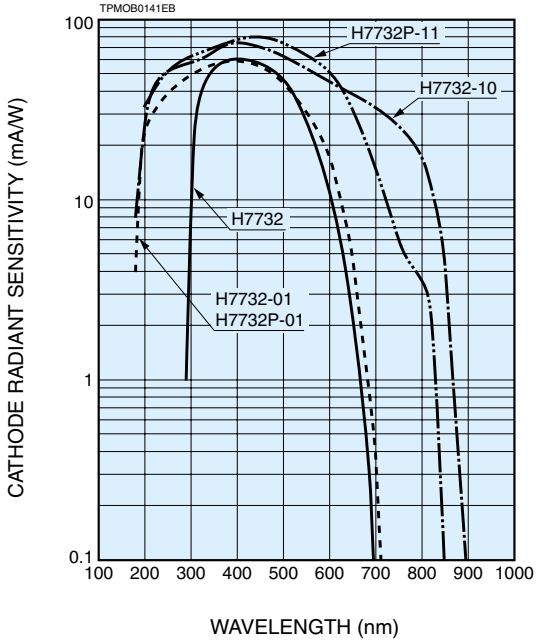
Type No.	Spectral Response	Features
H7732	300 nm to 650 nm	For general applications in visible range
H7732-01	185 nm to 680 nm	Low noise in UV to visible range
H7732-10	185 nm to 900 nm	High sensitivity in UV to near IR range. Uses photomultiplier tube with meshless grid for excellent uniformity.
H7732P-01	185 nm to 680 nm	For photon counting
H7732P-11	185 nm to 850 nm	

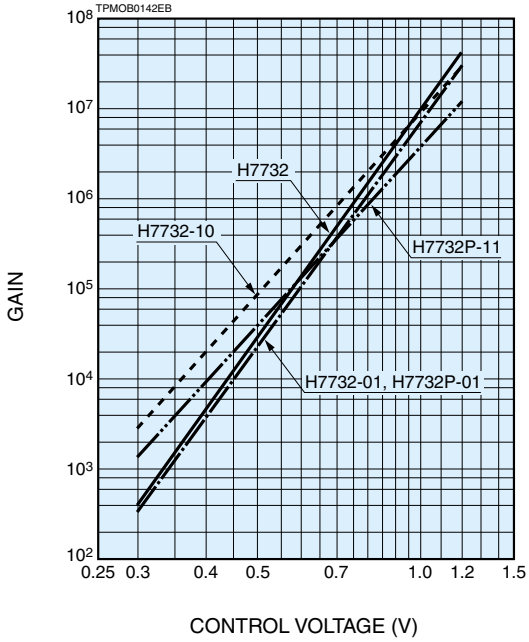
Specifications

Parameter			H7732	H7732-01	H7732-10	H7732P-01	H7732P-11	Unit
Input Voltage			+11.5 to +15.5					V
Max. Input Voltage			+18					V
Max. Input Current			40					mA
Max. Output Signal Current			100					μA
Max. Control Voltage			+1.2 (Input impedance 100 kΩ)					V
Recommended Control Voltage Adjustment Range			+0.3 to +1.1					V
Effective Area			4 × 20					mm
Sensitivity Adjustment Range			1: 10^4					—
Peak Sensitivity Wavelength			400				430	nm
Cathode	Luminous Sensitivity	Min.	30	40	140	40	140	μA/lm
		Typ.	60	60	250	60	200	
	Blue Sensitivity Index (CS 5-58)	Typ.	7.1	6.4	—	6.4	—	—
	Red/White Ratio	Typ.	—	—	0.3	—	0.15	—
	Radiant Sensitivity *1	Typ.	60	60	74	60	80	mA/W
Anode	Luminous Sensitivity *2	Min.	50	200	400	200	300	A/lm
		Typ.	600	400	2500	400	700	
	Radiant Sensitivity *1 *2	Typ.	6.0×10^5	4.0×10^5	7.4×10^5	4×10^5	2.8×10^5	A/W
	Dark Current *2 *3	Typ.	5	0.1	3	0.1	0.2	nA
		Max.	50	2	50	0.5	1	
	Dark Count *3 *4	Typ.	—	—	—	30	80	s^{-1}
		Max.	—	—	—	80	200	
Rise Time *2		Typ.	2.2					ns
Ripple Noise *2 *5 (peak to peak)		Max.	0.5					mV
Settling Time *6		Max.	0.2					s
Operating Ambient Temperature *7			+5 to +45					°C
Storage Temperature *7			-20 to +50					°C
Weight			220					g

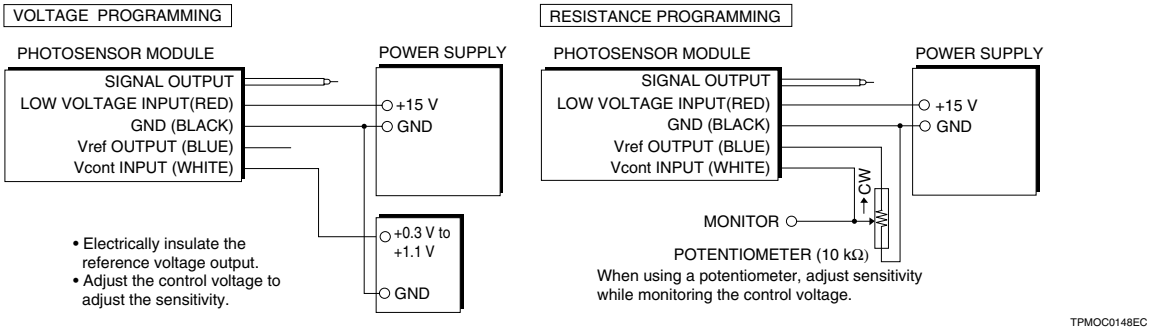
*1: Measured at the peak sensitivity wavelength *2: Control voltage = +1.0 V *3: After 30 minutes storage in darkness
*4: Control voltage: Plateau voltage
*5: Cable RG-174/U, Cable length 450 mm, load resistance = 1 MΩ, load capacitance = 22 pF
*6: The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V. *7: No condensation

Characteristics (Cathode radiant sensitivity, Gain)

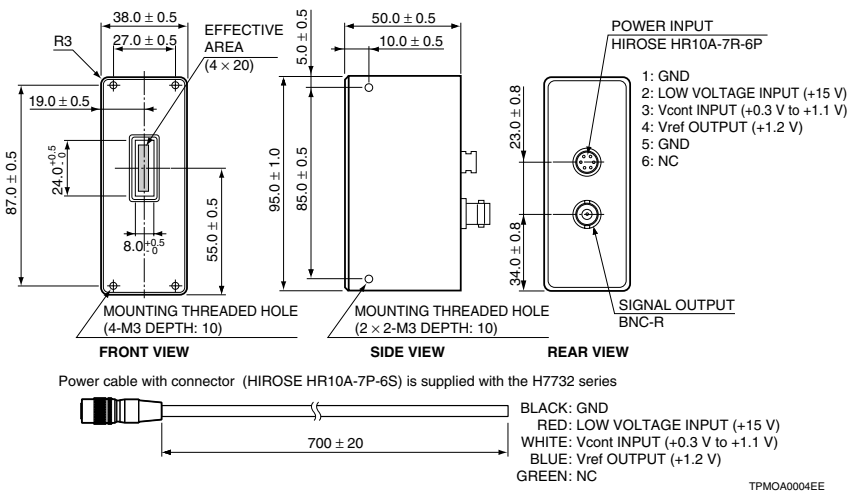


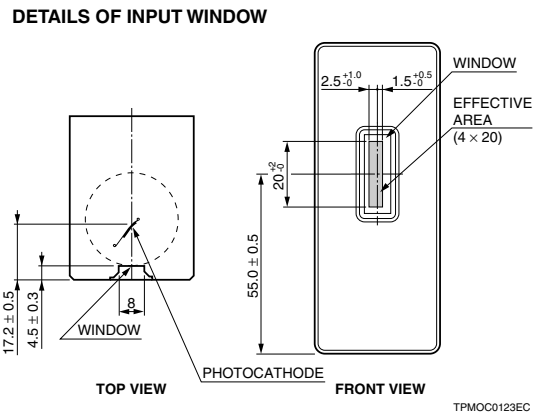


Sensitivity Adjustment Method



Dimensional Outlines (Unit: mm)





Compact Head-on PMT

Photosensor Modules H7826 Series

The H7826 series photosensor modules consist of a 19-mm (3/4") diameter head-on photomultiplier tube and a high-voltage power supply circuit. The length of the photomultiplier tube used here is short compared to other photomultiplier tubes of the same diameter, making it compact even though it has a large light input diameter of 15 mm. The H7826 also has excellent resistance to vibration and shock compared to other photomultiplier tubes, making it ideal for use in portable equipment.

Product Variations

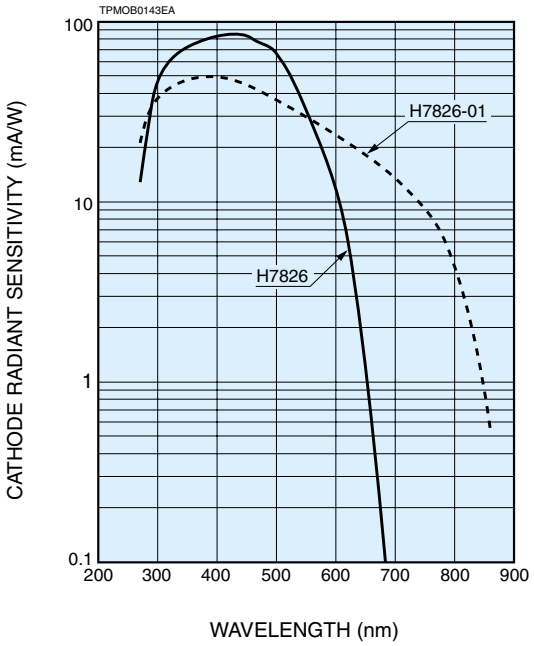
Type No.	Spectral Response	Features
H7826	300 nm to 650 nm	For general applications in visible range
H7826P		For photon counting
H7826-01	300 nm to 850 nm	For general applications in visible to near IR range
H7826P-01		For photon counting

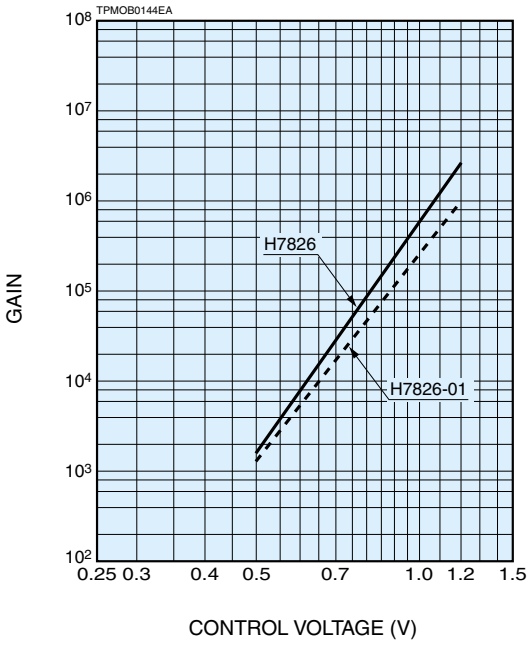
Specifications

Parameter			H7826	H7826-01	H7826P	H7826P-01	Unit
Input Voltage			+11.5 to +15.5				V
Max. Input Voltage			+18				V
Max. Input Current			40				mA
Max. Output Signal Current			100				μA
Max. Control Voltage			+1.2 (Input impedance 100 kΩ)				V
Recommended Control Voltage Adjustment Range			+0.5 to +1.1				V
Effective Area			φ15				mm
Sensitivity Adjustment Range			1: 10^3				—
Peak Sensitivity Wavelength			420	380	420	380	nm
Cathode	Luminous Sensitivity	Min.	60	80	60	80	μA/lm
		Typ.	90	120	90	120	
	Blue Sensitivity Index (CS 5-58)	Typ.	10.5	—	10.5	—	—
	Red/White Ratio	Typ.	—	0.2	—	0.2	—
	Radiant Sensitivity *1	Typ.	85	49	85	49	mA/W
Anode	Luminous Sensitivity *2	Min.	10		—		A/lm
		Typ.	50	30	—		
	Radiant Sensitivity *1 *2	Typ.	4.7×10^4	1.3×10^4	—		A/W
	Dark Current *2 *3	Typ.	3		3		nA
		Max.	20		20		
	Gain *2	Min.	—		1.8×10^6	1×10^6	—
	Dark Count *3 *4	Typ.	—		200	2000	s^{-1}
		Max.	—		500	3500	
Rise Time *2		Typ.	1.5				ns
Ripple Noise *2 *5 (peak to peak)		Max.	0.5				mV
Settling Time *6		Max.	0.2				s
Operating Ambient Temperature *7			+5 to +45				°C
Storage Temperature *7			-20 to +50				°C
Weight			70				g

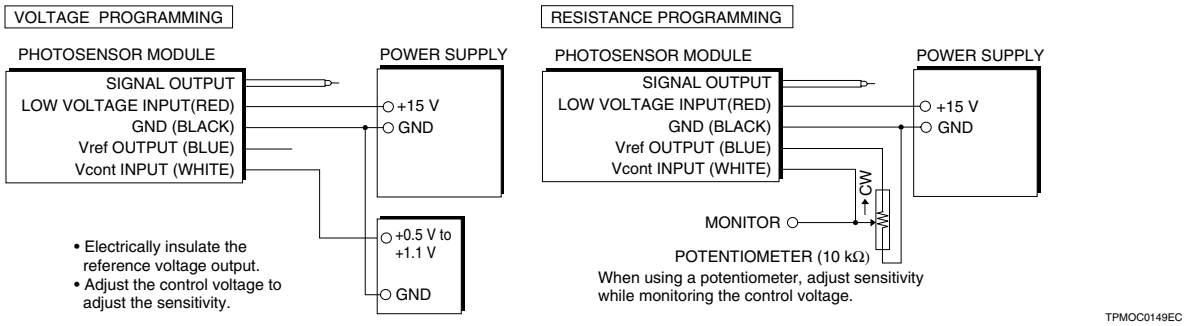
*1: Measured at the peak sensitivity wavelength *2: Control voltage = +1.0 V *3: After 30 minutes storage in darkness
*4: Control voltage: Plateau voltage *5: Cable RG-174/U, Cable length 450 mm, load resistance = 1 MΩ, load capacitance = 22 pF
*6: The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V. *7: No condensation

Characteristics (Cathode radiant sensitivity, Gain)

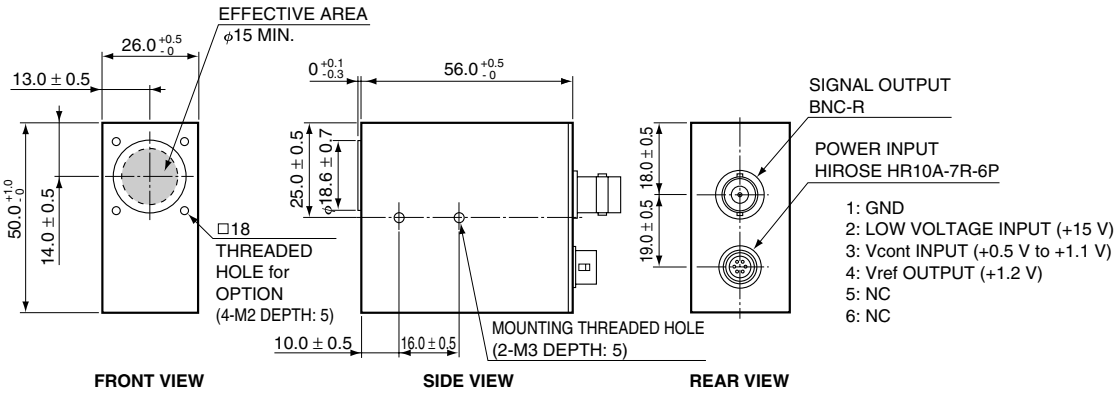




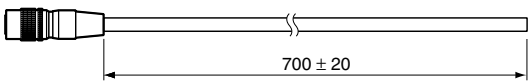
Sensitivity Adjustment Method



Dimensional Outlines (Unit: mm)



Power cable with connector (HIROSE HR10A-7P-6S) is supplied with the H7826 series



BLACK: GND
RED: LOW VOLTAGE INPUT (+15 V)
WHITE: Vcont INPUT (+0.5 V to +1.1 V)
BLUE: Vref OUTPUT (+1.2 V)
GREEN: NC

TPMOA0005ED

Head-on PMT

Photosensor Module H8443

The H8443 is a photosensor module that integrates a 25-mm (1") diameter head-on photomultiplier tube with a high-voltage power supply circuit. The H8443 has a large effective photocathode area of 22 mm diameter and features fast time response.

Product Variations

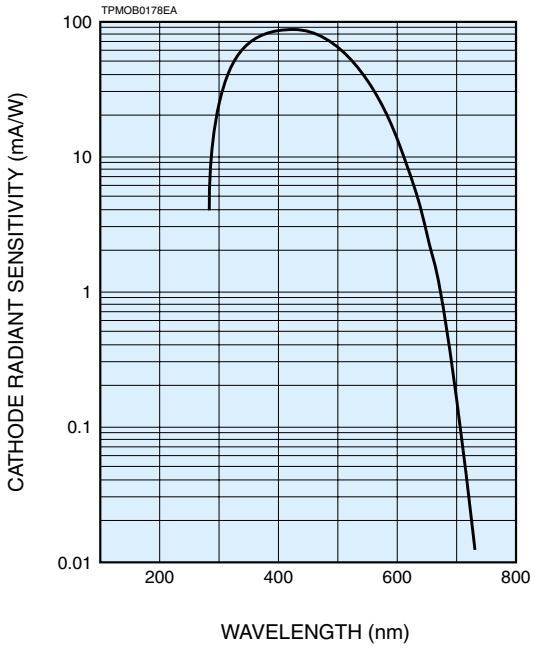
Type No.	Spectral Response	Features
H8443	300 nm to 650 nm	For visible range

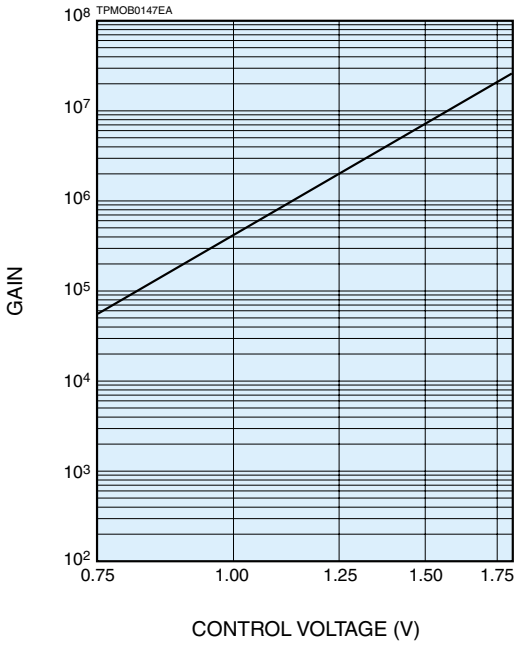
Specifications

Parameter			H8443	Unit
Input Voltage			+11.5 to +15.5	V
Max. Input Voltage			+18	V
Max. Input Current			40	mA
Max. Output Signal Current			100	μA
Max. Control Voltage			+1.8 (Input impedance 100 kΩ)	V
Recommended Control Voltage Adjustment Range			+0.75 to +1.50	V
Effective Area			φ22	mm
Sensitivity Adjustment Range			1: 10^2	—
Peak Sensitivity Wavelength			420	nm
Cathode	Luminous Sensitivity	Min.	70	μA/lm
		Typ.	95	
	Blue Sensitivity Index (CS 5-58)	Typ.	11	—
	Radiant Sensitivity *1	Typ.	88	mA/W
Anode	Luminous Sensitivity *2	Min.	20	A/lm
		Typ.	190	
	Radiant Sensitivity *1 *2	Typ.	1.7×10^5	A/W
	Dark Current *2 *3	Typ.	2	nA
		Max.	15	
Rise Time *2		Typ.	1.6	ns
Ripple Noise *2 *4 (peak to peak)		Max.	1	mV
Settling Time *5		Max.	0.2	s
Operating Ambient Temperature *6			+5 to +45	°C
Storage Temperature *6			-20 to +50	°C
Weight			210	g

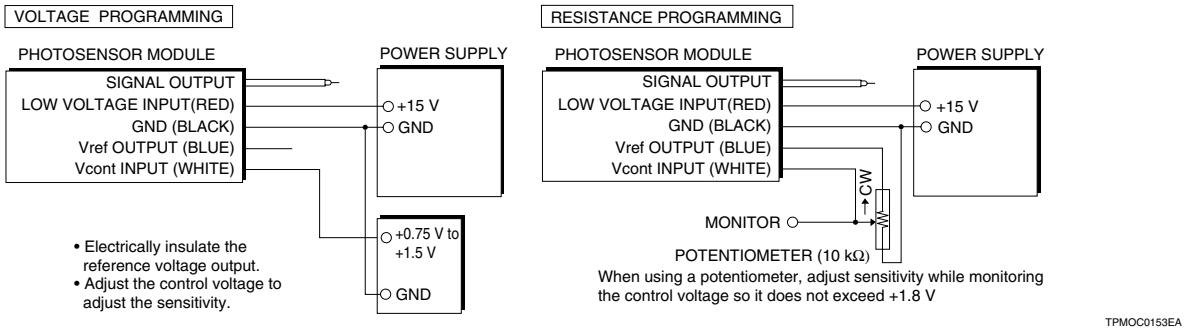
*1: Measured at the peak sensitivity wavelength *2: Control voltage = +1.25 V *3: After 30 minutes storage in darkness
*4: Cable RG-174/U, Cable length 450 mm, load resistance = 1 MΩ, load capacitance = 22 pF
*5: The time required for the output to reach a stable level following a change in the control voltage from +1.25 V to +0.75 V.
*6: No condensation

Characteristics (Cathode radiant sensitivity, Gain)

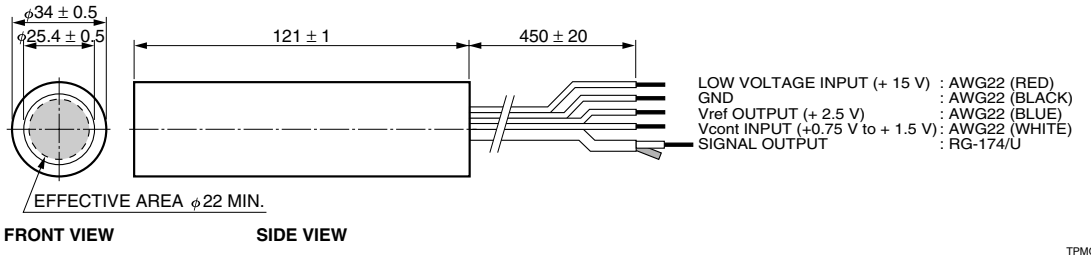




Sensitivity Adjustment Method



Dimensional Outline (Unit: mm)



Metal package PMT

Photosensor Modules H5784 Series

The H5784 series photosensor modules are comprised of a metal package photomultiplier tube, a low-power consumption high-voltage power supply and a low noise amplifier. The electrical current from the photomultiplier tube is converted to a voltage by an amplifier for easy signal processing. The H5784 is highly resistant to noise since the amplifier is installed near the anode output pin of the photomultiplier tube. The amplifier feedback resistance of 1 MΩ allows a current-to-voltage conversion factor of 1 V/μA, and covers a frequency bandwidth from DC to 20 kHz.

Product Variations

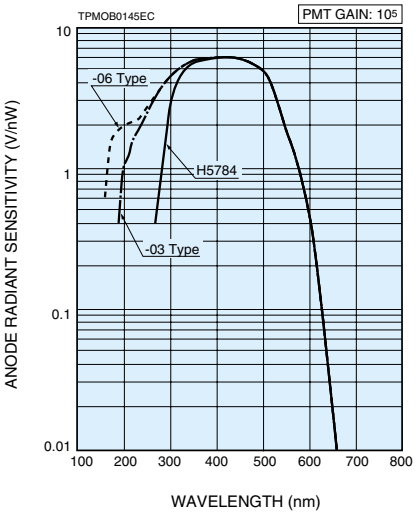
Type No.	Spectral Response	Current-to-voltage Conversion Factor	Frequency Bandwidth	Features
H5784	300 nm to 650 nm	1 V/μA	DC to 20 kHz	For general applications in visible range
H5784-01	300 nm to 850 nm			For general applications in visible to near IR range
H5784-02	300 nm to 880 nm			High sensitivity in near IR range
H5784-03	185 nm to 650 nm			For UV to visible range
H5784-04	185 nm to 850 nm			For UV to near IR range
H5784-06	185 nm to 650 nm			For UV to visible range (synthetic silica window) with higher sensitivity below 300 nm than -03 type
H5784-20	300 nm to 920 nm			Infrared-extended multialkali photocathode with enhanced sensitivity

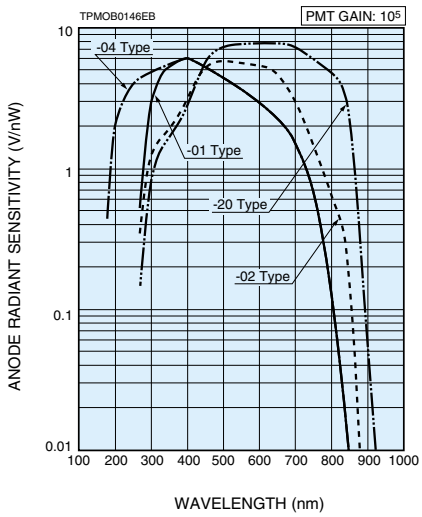
Specifications

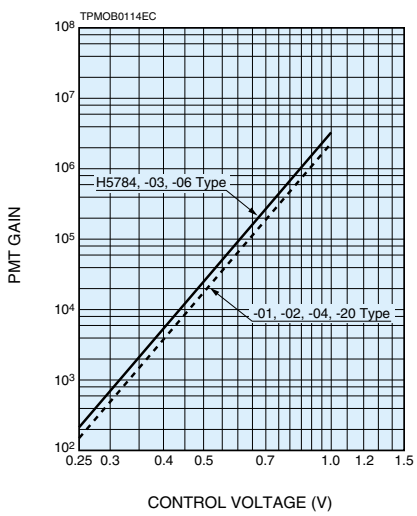
Parameter			H5784 Series				Unit
Suffix			None/-03/-06	-01/-04	-02	-20	—
Input Voltage			±11.5 to ±15.5				V
Max. Input Voltage			±18				V
Max. Input Current			+9/-1				mA
Max. Output Signal Voltage			+10 (Load resistance 10 kΩ)				V
Max. Control Voltage			+1.0 (Input impedance 100 kΩ)				V
Recommended Control Voltage Adjustment Range			+0.25 to +0.9				V
Effective Area			φ8				mm
Sensitivity Adjustment Range			$1: 10^4$				—
Peak Sensitivity Wavelength			420	400	500	630	nm
Cathode	Luminous Sensitivity	Min.	40	80	200	350	μA/lm
		Typ.	70	150	250	500	
	Blue Sensitivity Index (CS 5-58)	Typ.	8	—	—	—	—
	Red/White Ratio	Typ.	—	0.2	0.25	0.45	—
	Radiant Sensitivity *1	Typ.	62	60	58	78	mA/W
Anode	Luminous Sensitivity *2	Min.	1.0×10^7	1.5×10^7	2.5×10^7	3.5×10^7	V/lm
		Typ.	5.0×10^7	7.5×10^7	1.25×10^8	2.5×10^8	
	Radiant Sensitivity *1 *2	Typ.	43	30	29	39	V/nW
	Voltage Output Depending on PMT Dark Current *2 *3 *4	Typ.	0.2	0.4	2	2	mV
		Max.	2	4	20	20	
Current-to-Voltage Conversion Factor			1				V/μA
Offset Voltage		Typ.	±3				mV
Ripple Noise *2 *5 (peak to peak)		Max.	2				mV
Settling Time *6		Max.	2				s
Operating Ambient Temperature *7			+5 to +50				°C
Storage Temperature *7			-20 to +50				°C
Weight			100				g

*1: Measured at the peak sensitivity wavelength *2: Control voltage = +0.8 V *3: After 30 minutes storage in darkness
*4: Output of anode dark current *5: Cable RG-174/U, Cable length 450 mm, Load resistance = 1 MΩ, Load capacitance = 22 pF
*6: 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. *7: No condensation

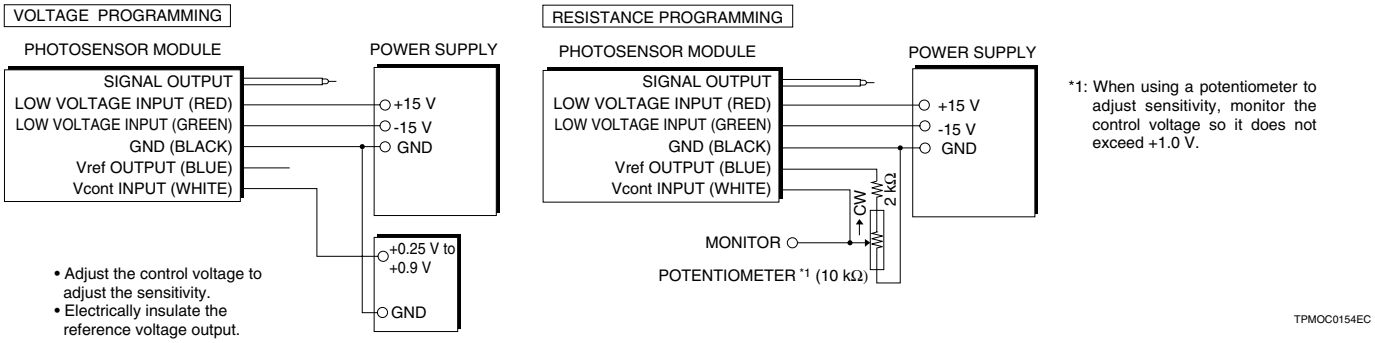
Characteristics (Anode radiant sensitivity, PMT gain)



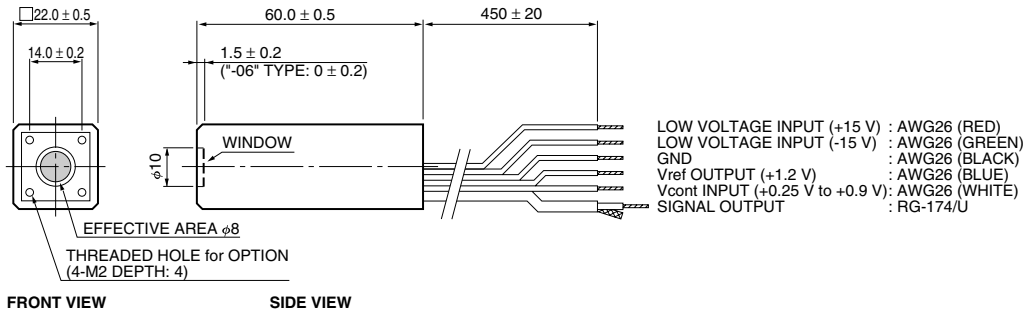




Sensitivity Adjustment Method

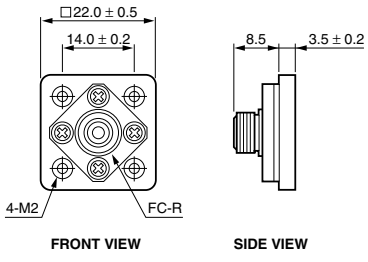


Dimensional Outlines (Unit: mm)

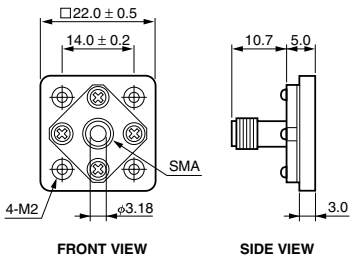


Options (Optical Fiber Adapter) (Unit: mm)

E5776 (FC Type)



E5776-51 (SMA Type)



Metal Package PMT

Photosensor Modules H9656 Series

The H9656 series photosensor modules incorporate a metal package photomultiplier tube, a high-voltage power supply circuit with low power consumption and a low noise amplifier. The photomultiplier tube output current is converted into a voltage output for easy signal processing.
The internal amplifier is installed near the anode output pin of the photomultiplier tube to minimize the effects of external noise. The amplifier feedback resistance of 100 kΩ allows a current-to-voltage conversion coefficient of 0.1 V/μA and covers a wide frequency bandwidth from DC to 200 kHz.

Product Variations

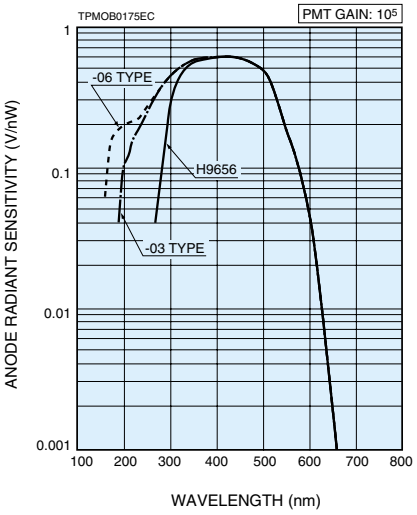
Type No.	Spectral Response	Current-to-voltage Conversion Factor	Frequency Bandwidth	Features
H9656	300 nm to 650 nm	0.1 V/μA	DC to 200 kHz	For general applications in visible range
H9656-01	300 nm to 850 nm			For general applications in visible to near IR range
H9656-02	300 nm to 880 nm			High sensitivity in near IR range
H9656-03	185 nm to 650 nm			For UV to visible range
H9656-04	185 nm to 850 nm			For UV to near IR range
H9656-06	185 nm to 650 nm			For UV to visible range (synthetic silica window) with higher sensitivity below 300 nm than -03 type
H9656-20	300 nm to 920 nm			Infrared-extended multialkali photocathode with enhanced sensitivity

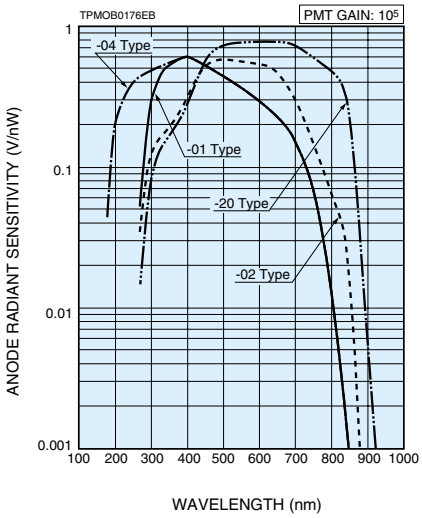
Specifications

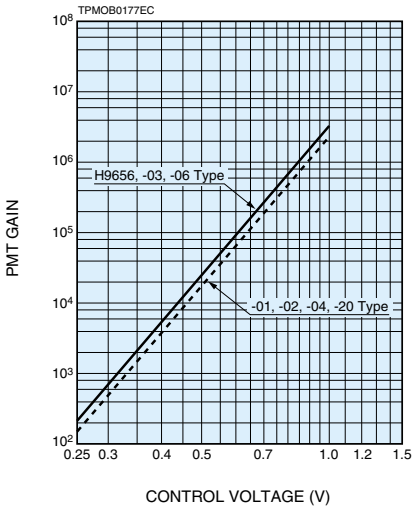
Parameter			H9656 Series				Unit
Suffix			None/-03/-06	-01/-04	-02	-20	—
Input Voltage			±11.5 to ±15.5				V
Max. Input Voltage			±18				V
Max. Input Current			+38/-8				mA
Max. Output Signal Voltage			+10 (Load resistance 10 kΩ)				V
Max. Control Voltage			+1.0 (Input impedance 100 kΩ)				V
Recommended Control Voltage Adjustment Range			+0.25 to +0.9				V
Effective Area			φ8				mm
Sensitivity Adjustment Range			1: 10^4				—
Peak Sensitivity Wavelength			420	400	500	630	nm
Cathode	Luminous Sensitivity	Min.	40	80	200	350	μA/lm
		Typ.	70	150	250	500	
	Blue Sensitivity Index (CS 5-58)	Typ.	8	—	—	—	—
	Red/White Ratio	Typ.	—	0.2	0.25	0.45	—
	Radiant Sensitivity *1	Typ.	62	60	58	78	mA/W
Anode	Luminous Sensitivity *2	Min.	1.0×10^6	1.5×10^6	2.5×10^6	3.5×10^6	V/lm
		Typ.	5.0×10^6	7.5×10^6	1.25×10^7	2.5×10^7	
	Radiant Sensitivity *1 *2	Typ.	4.3	3.0	2.9	3.9	V/nW
	Voltage Output Depending on PMT Dark Current *2 *3 *4	Typ.	0.02	0.04	0.2	0.2	mV
		Max.	0.2	0.4	2.0	2.0	
Current-to-Voltage Conversion Factor			0.1				V/μA
Offset Voltage		Typ.	±1				mV
Ripple Noise *2 *5 (peak to peak)		Max.	1.5				mV
Settling Time *6		Max.	0.2				s
Operating Ambient Temperature *7			+5 to +45				°C
Storage Temperature *7			-20 to +50				°C
Weight			90				g

*1: Measured at the peak sensitivity wavelength *2: Control voltage = +0.8 V *3: After 30 minutes storage in darkness
*4: Output of anode dark current *5: Cable RG-174/U, Cable length 450 mm, Load resistance = 1 MΩ, Load capacitance = 22 pF
*6: 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. *7: No condensation

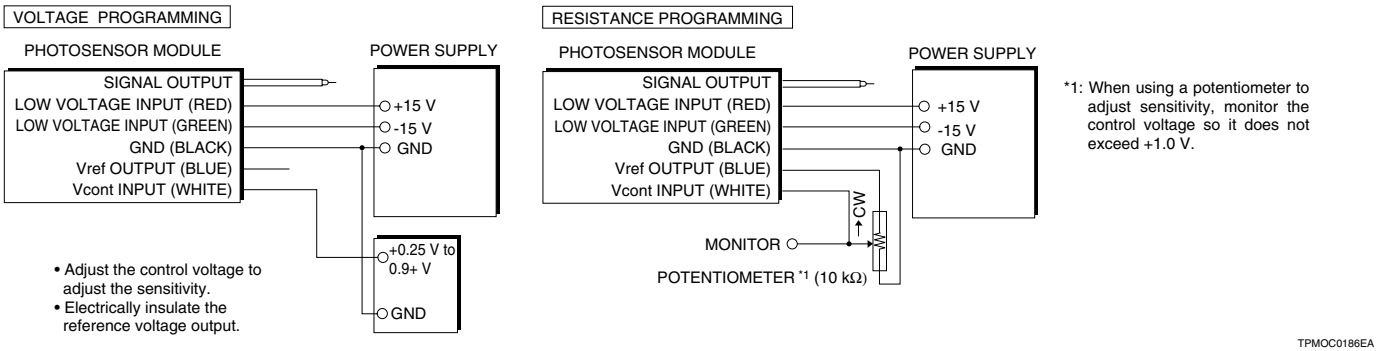
Characteristics (Anode radiant sensitivity, PMT gain)





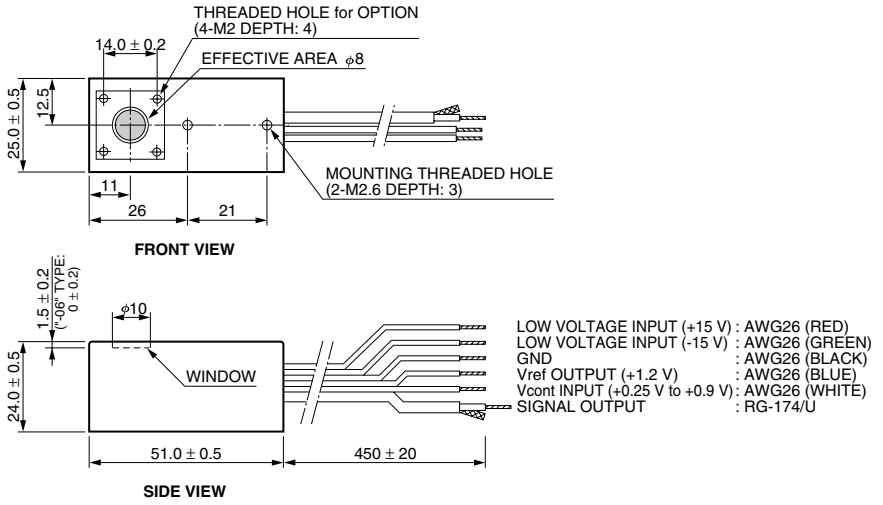


Sensitivity Adjustment Method



TPMOC0186EA

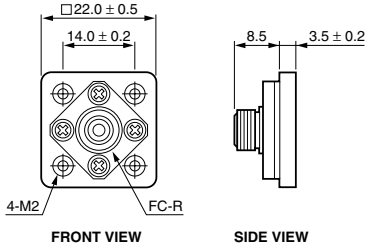
Dimensional Outlines (Unit: mm)



TPMOA0031EA

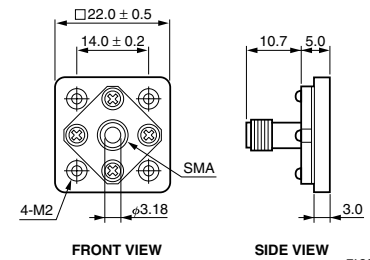
Options (Optical Fiber Adapter) (Unit: mm)

E5776 (FC Type)



TACCA0055EA

E5776-51 (SMA Type)



TACCA0239EA

Compact Side-on PMT

Photosensor Modules H9306/H9307 Series

The H9306/H9307 series photosensor modules incorporate a 13-mm (1/2") diameter side-on photomultiplier tube, a high-voltage power supply circuit and a low noise amplifier. Two types of amplifiers are available with a current-to-voltage conversion factor of 1 V/μA or 0.1 V/μA and a frequency bandwidth of 20 kHz or 200 kHz. The H9306/H9307 series uses a Cockcroft-Walton circuit with low power consumption.

Five types of photomultiplier tubes are provided as standard lineups to meet various needs for spectral response range. Flexible cables are used for easy installation equipment.

Product Variations

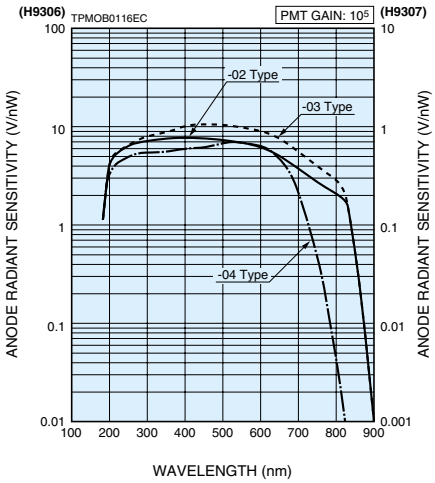
Type No.					Current-to-Voltage Conversion Factor	Frequency Bandwidth	Features
185 nm to 750 nm	185 nm to 900 nm	185 nm to 900 nm	185 nm to 830 nm	185 nm to 650 nm			
H9306-01	H9306-02	H9306-03	H9306-04	H9306-05	1 V/μA	DC to 20 kHz	Low power consumption
H9307-01	H9307-02	H9307-03	H9307-04	H9307-05	0.1 V/μA	DC to 200 kHz	

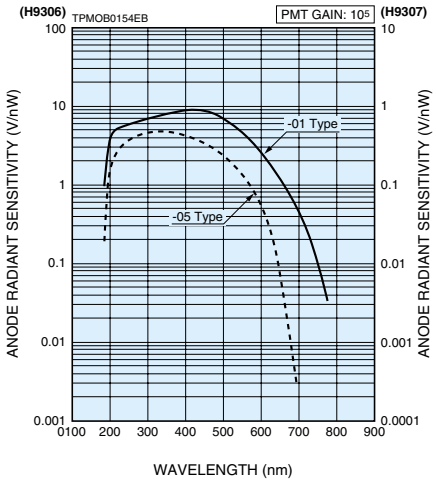
Specifications

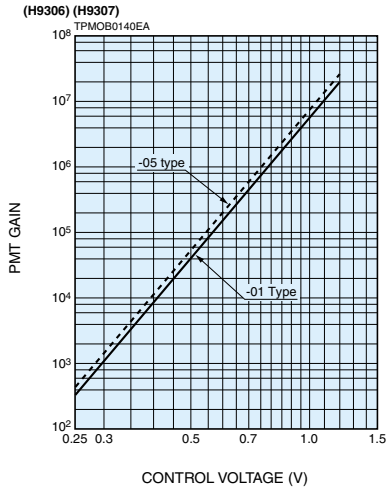
Parameter			H9306 / H9307 Series					Unit
Suffix			-01	-02	-03	-04	-05	—
Input Voltage			±11.5 to ±15.5					V
Max. Input Voltage			±18					V
Max. Input Current			+9/-1 (H9306), +15/-8 (H9307)					mA
Max. Control Voltage			+1.2 (Input Impedance: 1 MΩ)					V
Recommended Control Voltage Adjustment Range			+0.25 to +1.0					V
Effective Area			3.7 × 13.0					mm
Sensitivity Adjustment Range			1: 10^4					—
Peak Sensitivity Wavelength			420	400	450	530	340	nm
Cathode	Luminous Sensitivity	Min.	80	200	350	140	20	μA/lm
		Typ.	120	300	500	200	40	
	Blue Sensitivity Index (CS 5-58)	Typ.	10	—	—	—	5	—
	Red/White Ratio	Typ.	—	0.3	0.4	0.15	—	—
	Radiant Sensitivity *1	Typ.	90	77	105	70	48	mA/W
H9306 Series (with internal 20 kHz amp)								
Anode	Luminous Sensitivity *2	Min.	1.0×10^8	4.0×10^8	1.0×10^9	3.0×10^8	5.0×10^7	V/lm
		Typ.	7.0×10^8	2.0×10^9	2.0×10^9	7.0×10^8	3.0×10^8	
	Radiant Sensitivity *1 *2	Typ.	520	520	420	250	360	V/nW
	Voltage Output Depending on PMT Dark Current *2 *3 *4	Typ.	1	1	2	0.1	0.5	mV
		Max.	10	10	10	1	5	
Max. Output Signal Voltage			+10 (Load resistance 10 kΩ)					V
Current-to-Voltage Conversion Factor			1					V/μA
H9307 Series (with internal 200 kHz amp)								
Anode	Luminous Sensitivity *2	Min.	1.0×10^7	4.0×10^7	1.0×10^8	3.0×10^7	5.0×10^6	V/lm
		Typ.	7.0×10^7	2.0×10^8	2.0×10^8	7.0×10^7	3.0×10^7	
	Radiant Sensitivity *1 *2	Typ.	52	52	42	25	36	V/nW
	Voltage Output Depending on PMT Dark Current *2 *3 *4	Typ.	0.1	0.1	0.2	0.01	0.05	mV
		Max.	1	1	1	0.1	0.5	
Max. Output Signal Voltage			+1 (Load resistance 10 kΩ)					V
Current-to-Voltage Conversion Factor			0.1					V/μA
			H9306 / H9307 Series					
Offset Voltage		Typ.	±3					mV
Ripple Noise *2 *5 (peak to peak)		Max.	0.8					mV
Settling Time *6		Max.	10					s
Operating Ambient Temperature *7			+5 to +50					°C
Storage Temperature *7			-20 to +50					°C
Weight			110					g

*1: Measured at the peak sensitivity wavelength *2: Control voltage = +1.0 V *3: After 30 minutes storage in darkness
*4: Output of anode dark current
*5: Cable RG-174/U, Cable length 450 mm, Load resistance = 1 MΩ, Load capacitance = 22 pF
*6: 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. *7: No condensation

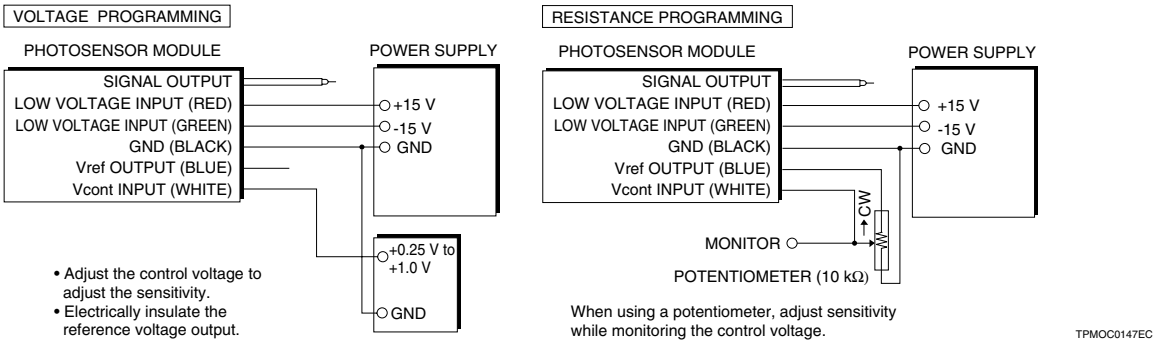
Characteristics (Anode radiant sensitivity, PMT gain)



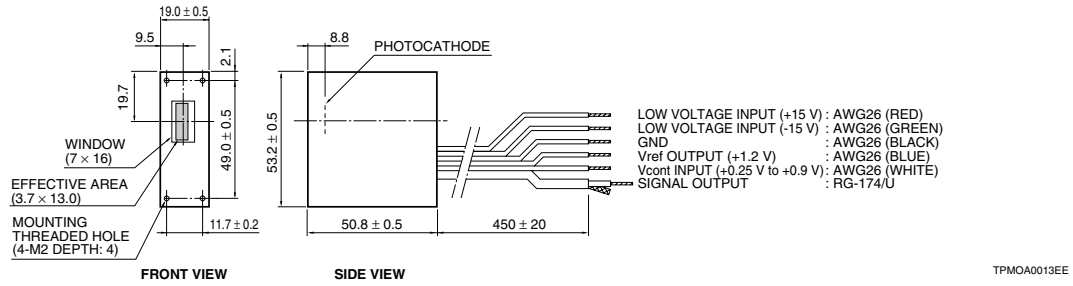




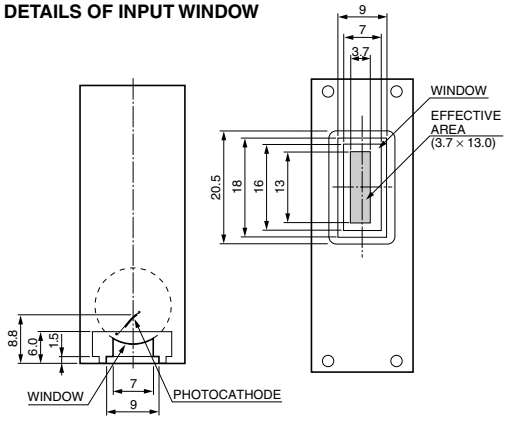
Sensitivity Adjustment Method



Dimensional Outlines (Unit: mm)



DETAILS OF INPUT WINDOW



Side-on PMT

Photosensor Modules H8249 Series

The H8249 series photosensor modules incorporate a 28-mm (1-1/8") diameter side-on photomultiplier tube, a high-voltage power supply circuit and a low noise amplifier. Two types of amplifiers are available with a current-to-voltage conversion factor of 1 V/µA or 0.1 V/µA and a frequency bandwidth of DC to 20 kHz or DC to 200 kHz. Three types of photomultiplier tubes are provided as standard lineups for general applications in the visible range, UV to visible range requiring low-noise, and UV to near IR range.

Product Variations

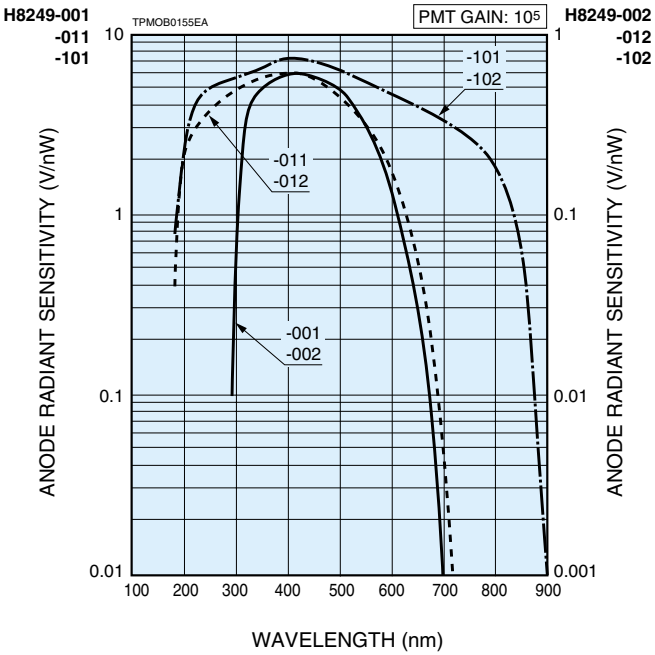
Type No.	Spectral Response	Current-to-Voltage Conversion Factor	Frequency Bandwidth	Features
H8249-001	300 nm to 650 nm	1 V/µA	DC to 20 kHz	For general applications in visible range
H8249-011	185 nm to 680 nm			For general applications in UV to visible range
H8249-101	185 nm to 900 nm			High sensitivity in UV to near IR range. Uses photomultiplier tube with meshless grid for excellent uniformity.
H8249-002	300 nm to 650 nm	0.1 V/µA	DC to 200 kHz	For general applications in visible range
H8249-012	185 nm to 680 nm			For general applications in UV to visible range
H8249-102	185 nm to 900 nm			High sensitivity in UV to near IR range. Uses photomultiplier tube with meshless grid for excellent uniformity.

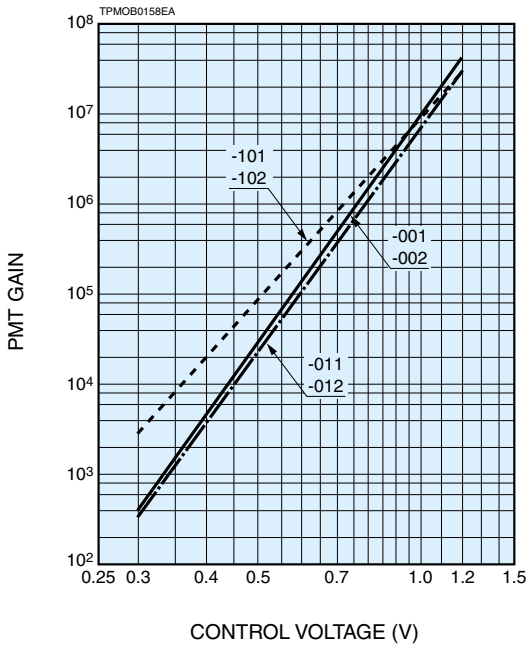
Specifications

Parameter			H8249 Series			Unit
Suffix			-001 / -002	-011 / -012	-101 / -102	—
Input Voltage			±11.5 to ±15.5			V
Max. Input Voltage			±18			V
Max. Input Current			+45/-1 (-001/-011/-101), +55/-15 (-002/-012/-102)			mA
Max. Control Voltage			+1.2 (Input Impedance 100 kΩ)			V
Recommended Control Voltage Adjustment Range			+0.3 to +1.1			V
Effective Area			4 × 20			mm
Sensitivity Adjustment Range			1: 10^4			—
Peak Sensitivity Wavelength			400			nm
Cathode	Luminous Sensitivity	Min.	30	40	140	µA/lm
		Typ.	60	60	250	
	Blue Sensitivity Index (CS 5-58)	Typ.	7.1	6.4	8.0	—
	Red/White Ratio	Typ.	—	—	0.3	—
	Radiant Sensitivity *1	Typ.	60	60	74	mA/W
Suffix (with internal 20 kHz amp)			-001	-011	-101	
Anode	Luminous Sensitivity *2	Min.	5.0×10^7	2.0×10^8	4.0×10^8	V/lm
		Typ.	6.0×10^8	4.0×10^8	2.5×10^9	
	Radiant Sensitivity *1 *2	Typ.	600	400	740	V/nW
	Voltage Output Depending on PMT Dark Current *2 *3 *4	Typ.	5	0.1	3	mV
		Max.	50	2	50	
Max. Output Signal Voltage			+10 (Load resistance 10 kΩ)			V
Current-to-Voltage Conversion Factor			1			V/µA
Suffix (with internal 200 kHz amp)			-002	-012	-102	
Anode	Luminous Sensitivity *2	Min.	5.0×10^6	2.0×10^7	4.0×10^7	V/lm
		Typ.	6.0×10^7	4.0×10^7	2.5×10^8	
	Radiant Sensitivity *1 *2	Typ.	60	40	74	V/nW
	Voltage Output Depending on PMT Dark Current *2 *3 *4	Typ.	0.5	0.01	0.3	mV
		Max.	5	0.2	5	
Max. Output Signal Voltage			+10 (Load resistance 10 kΩ)			V
Current-to-Voltage Conversion Factor			0.1			V/µA
			H8249 series			
Offset Voltage		Typ.	±3			mV
Ripple Noise *2 *5 (peak to peak)		Max.	0.6			mV
Settling Time *6		Max.	0.2			s
Operating Ambient Temperature *7			+5 to +45			°C
Storage Temperature *7			-20 to +50			°C
Weight			220			g

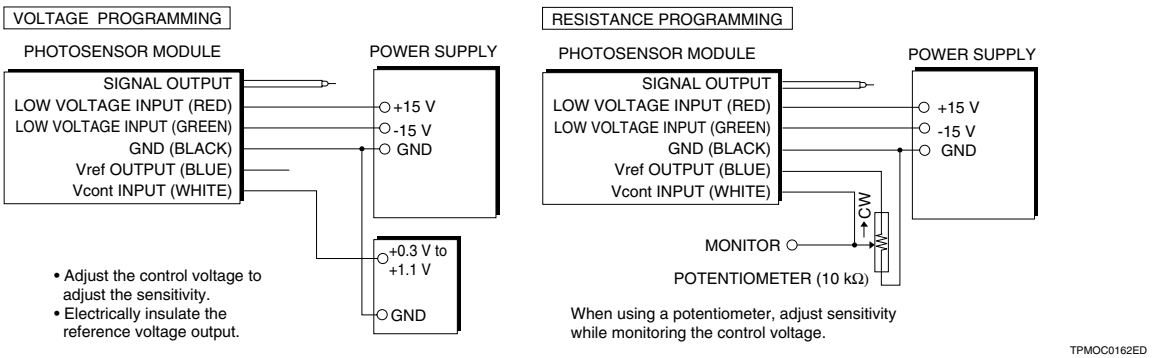
*1: Measured at the peak sensitivity wavelength *2: Control voltage = +1.0 V *3: After 30 minutes storage in darkness
*4: Output of anode dark current *5: Cable RG-174/U, Cable length 450 mm, Load resistance = 1 MΩ, Load capacitance = 22 pF
*6: The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V. *7: No condensation

Characteristics (Anode radiant sensitivity, PMT gain)

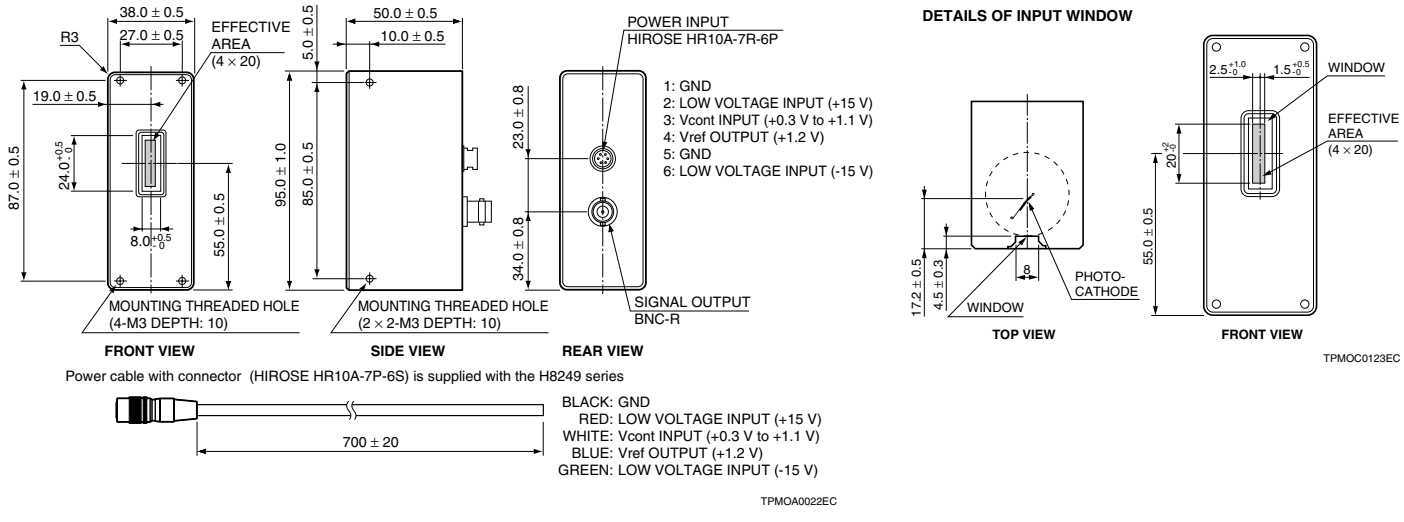




Sensitivity Adjustment Method



Dimensional Outlines (Unit: mm)



Compact Head-on PMT

Photosensor Modules H7827 Series

The H7827 series photosensor modules incorporate a 19-mm (3/4") diameter head-on photomultiplier tube, a high-voltage power supply circuit and a low noise amplifier. Two types of amplifiers are available with a current-to-voltage conversion factor of 1 V/µA or 0.1 V/µA and a frequency bandwidth of DC to 20 kHz or DC to 200 kHz. Two types of photomultiplier tubes with different spectral response characteristics are provided for measurement in the visible range or visible to near IR range.

Product Variations

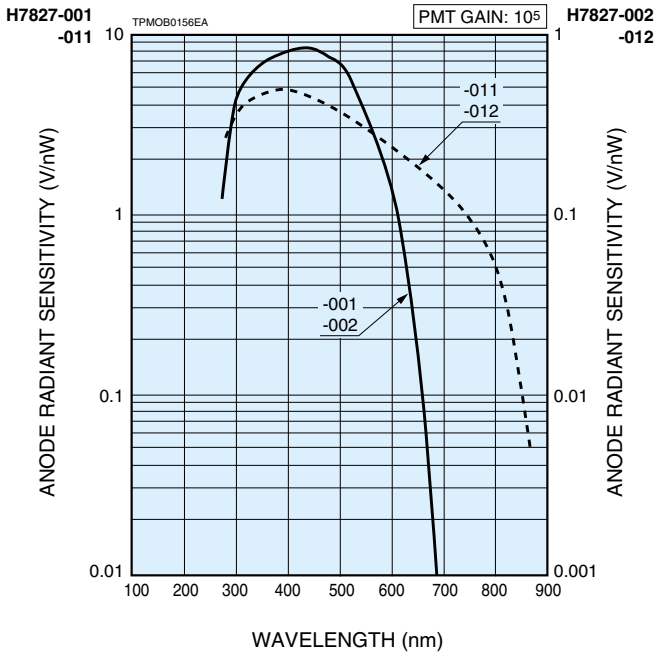
Type No.	Spectral Response	Current-to-Voltage Conversion Factor	Frequency Bandwidth	Features
H7827-001	300 nm to 650 nm	1 V/µA	DC to 20 kHz	For general applications in visible range
H7827-011	300 nm to 850 nm			For visible to near IR range
H7827-002	300 nm to 650 nm	0.1 V/µA	DC to 200 kHz	For general applications in visible range
H7827-012	300 nm to 850 nm			For visible to near IR range

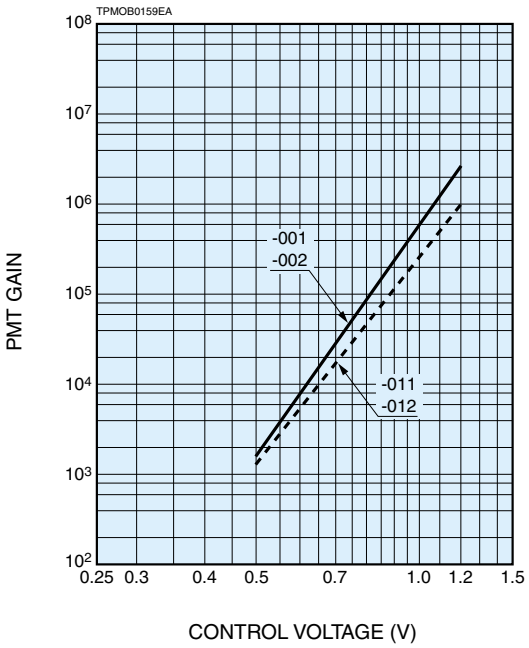
Specifications

Parameter			H7827 Series		Unit
Suffix			-001 / -002	-011 / -012	—
Input Voltage			±11.5 to ±15.5		V
Max. Input Voltage			±18		V
Max. Input Current			+45/-1 (-001/-011), +50/-8 (-002/-012)		mA
Max. Control Voltage			+1.2 (Input Impedance 100 kΩ)		V
Recommended Control Voltage Adjustment Range			+0.5 to +1.1		V
Effective Area			φ15		mm
Sensitivity Adjustment Range			1: 10^3		—
Peak Sensitivity Wavelength			420	380	nm
Cathode	Luminous Sensitivity	Min.	60	80	µA/lm
		Typ.	90	120	
	Blue Sensitivity Index (CS 5-58)	Typ.	10.5	—	—
	Red/White Ratio	Typ.	—	0.2	—
	Radiant Sensitivity *1	Typ.	85	49	mA/W
Suffix (with internal 20 kHz amp)			-001	-011	
Anode	Luminous Sensitivity *2	Min.	1.0×10^7	1.0×10^7	V/lm
		Typ.	5.0×10^7	3.0×10^7	
	Radiant Sensitivity *1 *2	Typ.	47	13	V/nW
	Voltage Output Depending on PMT Dark Current *2 *3 *4	Typ.	3	3	mV
		Max.	20	20	
Max. Output Signal Voltage			+10 (Load resistance 10 kΩ)		V
Current-to-Voltage Conversion Factor			1		V/µA
Suffix (with internal 200 kHz amp)			-002	-012	
Anode	Luminous Sensitivity *2	Min.	1.0×10^6	1.0×10^6	V/lm
		Typ.	5.0×10^6	3.0×10^6	
	Radiant Sensitivity *1 *2	Typ.	4.7	1.3	V/nW
	Voltage Output Depending on PMT Dark Current *2 *3 *4	Typ.	0.3	0.3	mV
		Max.	2	2	
Max. Output Signal Voltage			+10 (Load resistance 10 kΩ)		V
Current-to-Voltage Conversion Factor			0.1		V/µA
			H7827 series		
Offset Voltage		Typ.	±3		mV
Ripple Noise *2 *5 (peak to peak)		Max.	0.6		mV
Settling Time *6		Max.	0.2		s
Operating Ambient Temperature *7			+5 to +45		°C
Storage Temperature *7			-20 to +50		°C
Weight			80		g

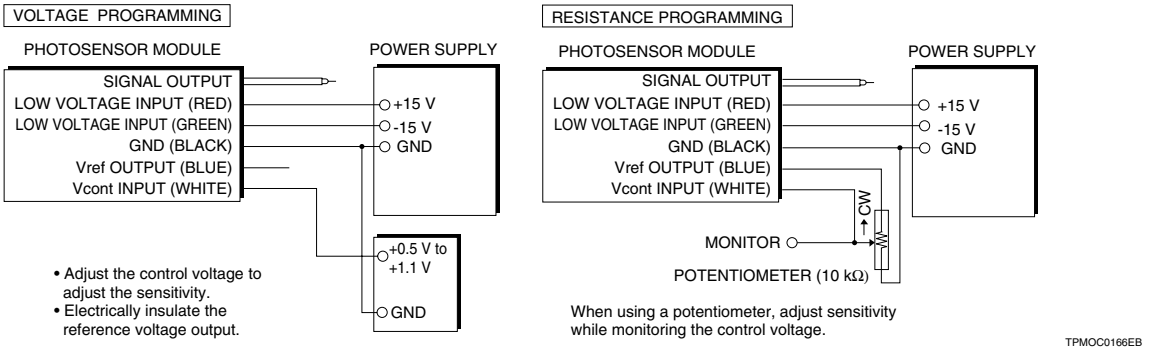
*1: Measured at the peak sensitivity wavelength *2: Control voltage = +1.0 V *3: After 30 minutes storage in darkness
*4: Output of anode dark current *5: Cable RG-174/U, Cable length 450 mm, Load resistance = 1 MΩ, Load capacitance = 22 pF
*6: The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V *7: No condensation.

Characteristics (Anode radiant sensitivity, PMT gain)

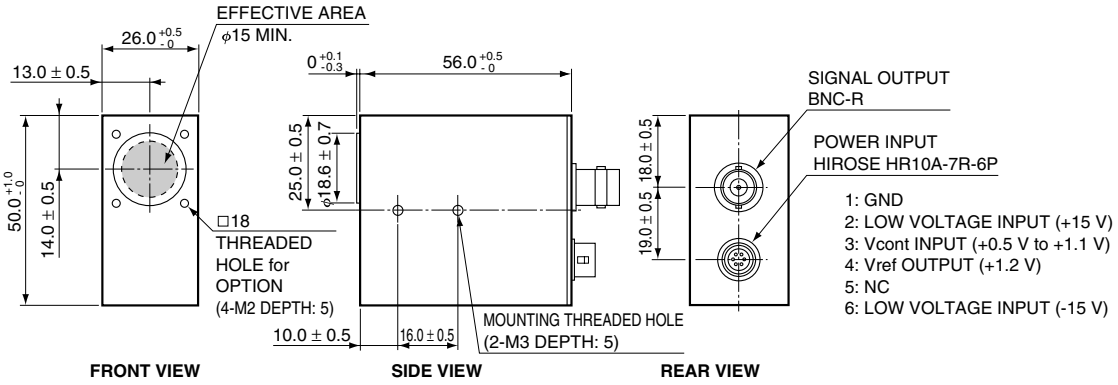




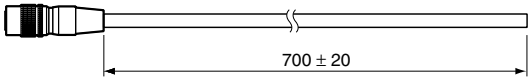
Sensitivity Adjustment Method



Dimensional Outlines (Unit: mm)



Power cable with connector (HIROSE HR10A-7P-6S) is supplied with the H7827 series

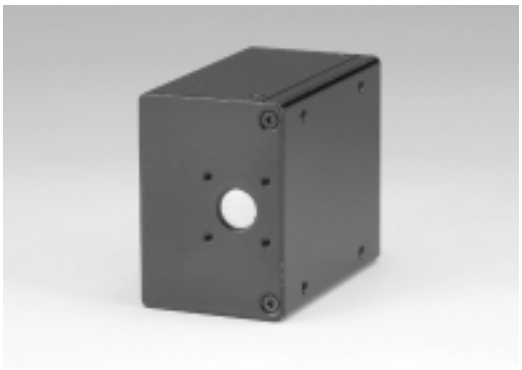


BLACK: GND
RED: LOW VOLTAGE INPUT (+15 V)
WHITE: Vcont INPUT (+0.5 V to +1.1 V)
BLUE: Vref OUTPUT (+1.2 V)
GREEN: LOW VOLTAGE INPUT (-15 V)

TPMOA0023EB

Metal Package PMT with Internal Charge Amp+ADC Type

Photosensor Modules H7468 Series



The H7468 series are photosensor modules assembled with a photomultiplier tube, an AD converter circuit and a microcontroller. These photosensor modules operate from a single +5 V supply and convert the photomultiplier tube analog signals into 12-bit digital data which can be sent to a PC (personal computer) through the RS-232C interface. The photomultiplier tube supply voltage and measurement start/stop can also be controlled from the PC.

Product Variations

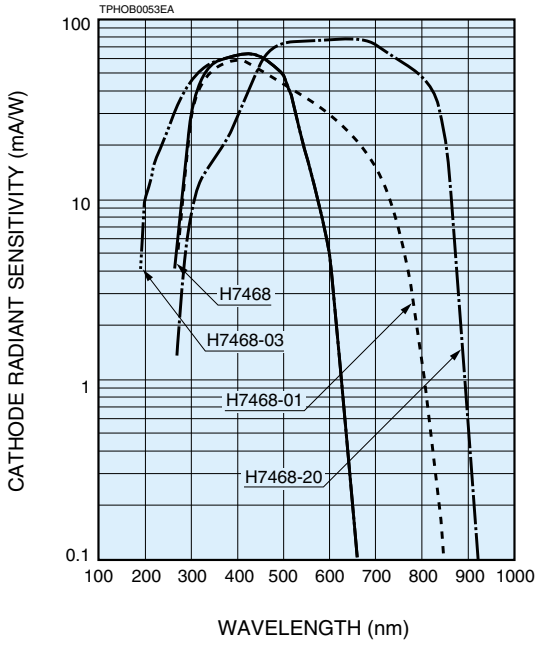
Type No.	Spectral Response	Features
H7468	300 nm to 650 nm	For visible range
H7468-01	300 nm to 850 nm	For visible to near IR range
H7468-03	185 nm to 650 nm	For UV to visible range
H7468-20	300 nm to 920 nm	High sensitivity in near IR range

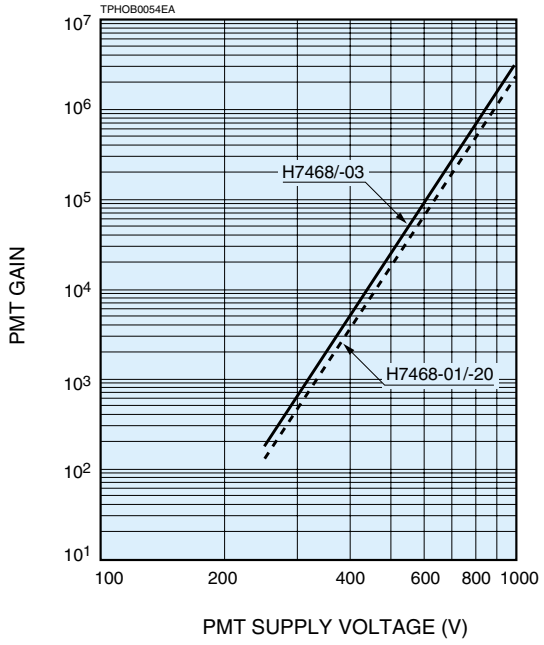
Specifications

Parameter			H7468				Unit
Suffix			None	-01	-03	-20	—
Input Voltage (Vcc)			+4.75 to +5.25				V
Max. Input Voltage			+6				V
Max. Input Current			35				mA
Effective Area			ϕ8				mm
Digital Output: Maximum Output Current			25				mA
Digital Output: Maximum Sink Current			25				mA
Voltage between Digital Input and GND			-0.3 to Vcc +0.3				V
Peak Sensitivity Wavelength			420	400	420	630	nm
Cathode Sensitivity	Luminous Sensitivity	Min.	40	80	40	350	μA/lm
		Typ.	70	150	70	500	
	Blue Sensitivity Index (CS 5-58)	Typ.	8.0	—	8.0	—	—
	Red/White Ratio	Typ.	—	0.2	—	0.45	—
	Radiant Sensitivity *1	Typ.	62	60	62	78	mA/W
Gain *2		Typ.	7.0×10^5	5.0×10^5	7.0×10^5	5.0×10^5	—
Anode Dark Current *2, *3		Typ.	0.2	0.4	0.2	2	nA
		Max.	2	4	2	20	
Integration Capacitance			1000				pF
AD Converter Resolution			12				bit
Integration Time			0.04 to 500 (0.01 step)				ms
Dead Time			0.01 to 500 (0.01 step)				ms
Sampling Time	Continuous Reading		4 to 1000				ms
	Fixed Set Reading		0.05 to 1000				ms
Measurement Count (fixed set reading)			1 to 127				—
PMT Supply Voltage			0 to 1000				V
Digital High-Level Input Voltage		Min.	4				V
Digital Low-Level Input Voltage		Max.	1				V
Digital High-Level Output Voltage		Min.	Vcc -0.7				V
Digital Low-Level Output Voltage		Max.	0.6				V
RS-232C Interface Setting			RS-232C, 9600 baud, Parity none, 8 data bits, 1 stop bit				—
Operating Ambient Temperature *4			+5 to +50				°C
Storage Temperature *4			-20 to +50				°C
Weight			105				g

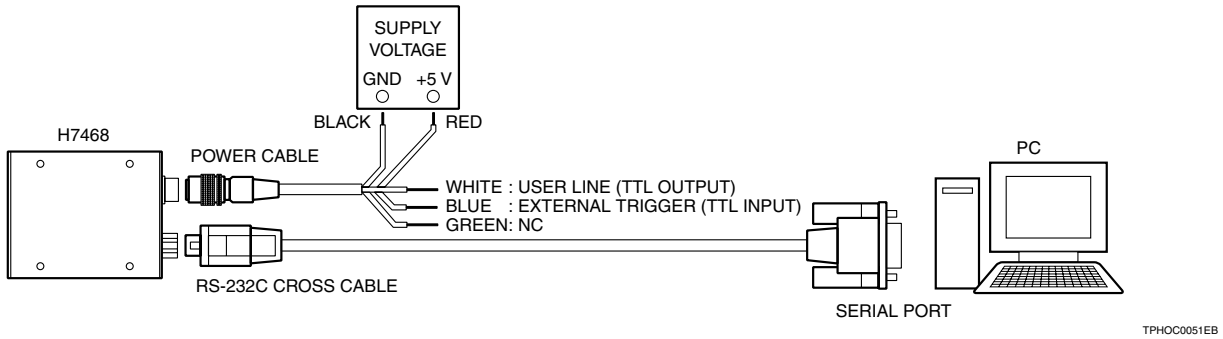
*1: Measured at the peak sensitivity wavelength *2: PMT supply voltage: 800 V
*3: After 30 minutes storage in darkness *4: No condensation

Characteristics (Cathode radiant sensitivity, PMT gain)

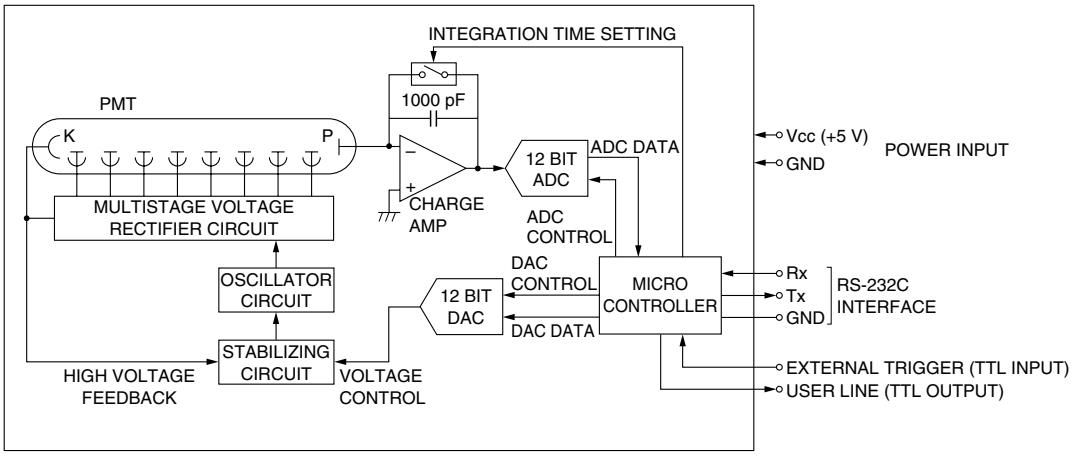




Connection Diagram



Block Diagram

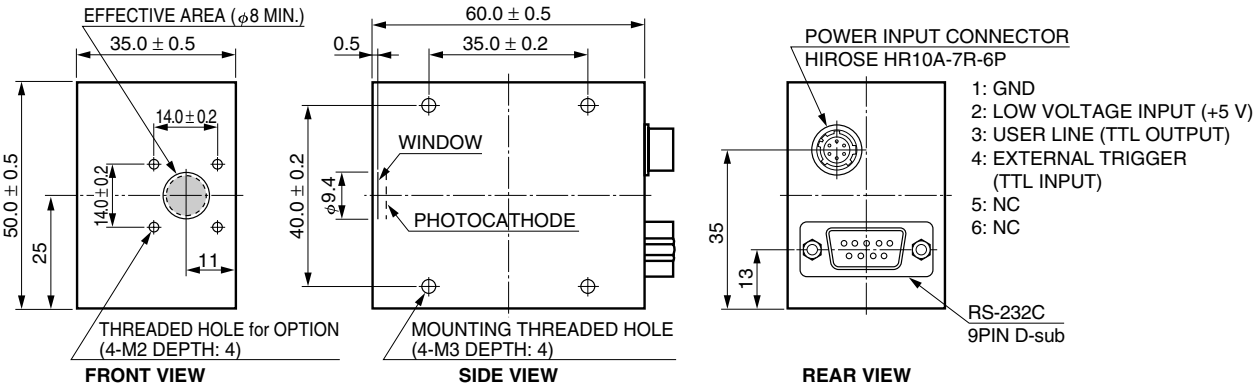


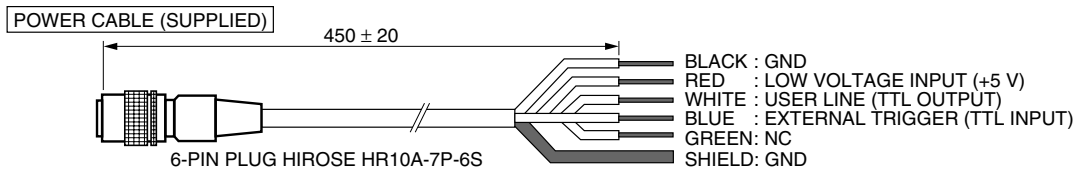
Command List

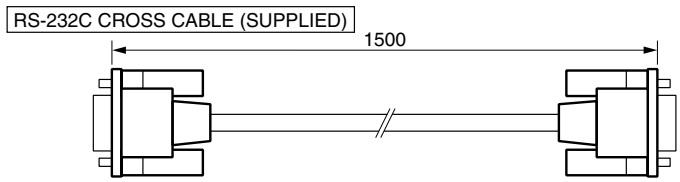
Action		Command *1	Argument (#)	Response *2
Change the High Voltage Applied to the PMT		V##CR	0 to 1000 (0 to 1000 V)	VA, BC, BA
Set the Integration Time		I##CR	4 to 50000 (40 µs to 500 ms)	VA, BC, BA
Set the Dead Time		T##CR	1 to 50000 (10 µs to 500 ms)	VA, BC, BA
Set Sequence of Readings		R#CR	0 to 127	VA, BC, BA
Start the Reading Sequence	Fixed Set with RS-232C Trigger	SCR	—	data
	Fixed Set with External Trigger	ECR	—	
	Continuous with RS-232C Trigger	CCR	—	
	Continuous with External Trigger	LCR	—	
Stop the Reading Sequence		CR	—	—
Set the Output of the User Line		O#CR	0 or 1	VA, BC, BA
Data		2 bytes binary data (not characters)		
Data Transfer	Fixed Set	The host prepares the H7468 to take a fixed set of "R" readings after sending a start command "S CR" or "E CR" with external trigger on.		
	Continuous with RS-232C Trigger	The host collects data continuously after sending a start command "C CR" until receiving a stop command "CR".		
	Continuous with External Trigger	The host collects data continuously after sending a start command "L CR" with external trigger on until receiving a stop command "CR" or external trigger off.		

*1: # is 1 byte data
*2: VA: command is valid, BC: command is bad, BA: argument is bad

Dimensional Outlines (Unit: mm)







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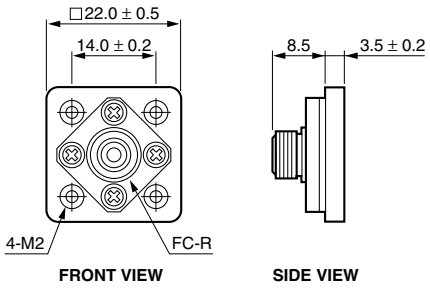
Options

(Optical Fiber Adapter) (Unit: mm)

E5776 (FC Type)



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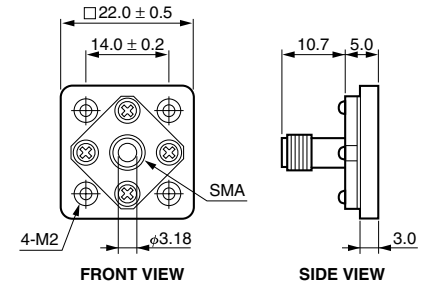
E5776-51 (SMA Type)



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Metal package PMT

Photon Counting Head H7155 Series

The H7155 series are compact photon counting head devices consisting of a metal package photomultiplier tube along with a high-speed photon counting circuit and a high-voltage power supply circuit. The high voltage supply for photomultiplier tube and the discriminator level are preset to optimum values, allowing photon counting measurement by just connecting a +5 V supply.
The H7155-20/H7155-21 has an internal prescaler of division by 4. This prescaler improves the count linearity compared to the H7155/H7155-01.

Product Variations

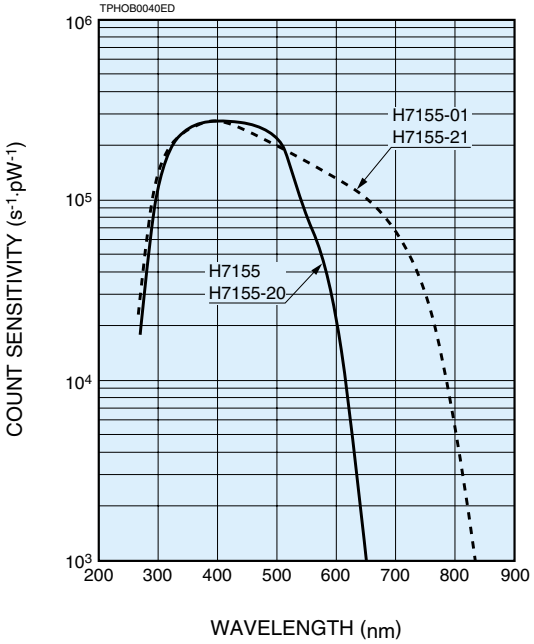
Type No.	Spectral Response	Prescaler
H7155	300 nm to 650 nm	no
H7155-01	300 nm to 850 nm	
H7155-20	300 nm to 650 nm	yes
H7155-21	300 nm to 850 nm	

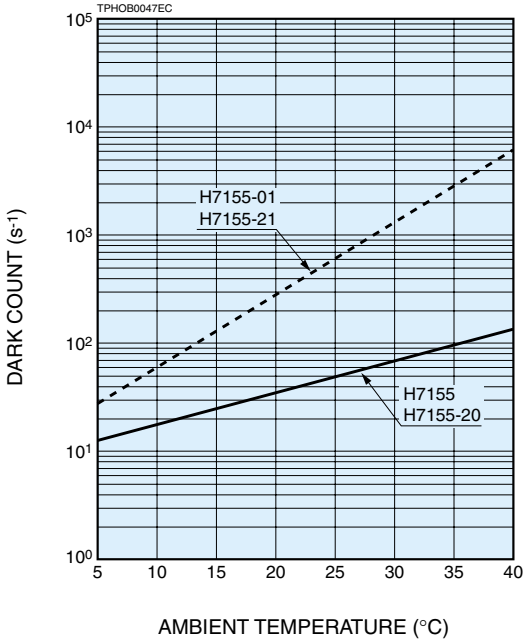
Specifications

Parameter			H7155	H7155-20	H7155-01	H7155-21	Unit
Input Voltage			+4.5 to +5.5				V
Max. Input Voltage			+6				V
Max. Input Current			50	70	50	70	mA
Effective Area			ϕ8				mm
Peak Sensitivity Wavelength			420		400		nm
Count Sensitivity	Typ.	300 nm	1.2×10^5	1.2×10^5 *2	1.2×10^5	1.2×10^5 *2	$s^{-1} \cdot pW^{-1}$
		400 nm	2.7×10^5	2.7×10^5 *2	2.7×10^5	2.7×10^5 *2	
		500 nm	2.2×10^5	2.2×10^5 *2	2.0×10^5	2.0×10^5 *2	
		600 nm	2.1×10^4	2.1×10^4 *2	1.4×10^5	1.4×10^5 *2	
		700 nm	—	—	6.7×10^4	6.7×10^4 *2	
Count Linearity *1			1.5×10^6	10×10^6 *2	1.5×10^6	10×10^6 *2	s^{-1}
Dark Count *3		Typ.	50	50 *2	600	600 *2	s^{-1}
		Max.	100	100 *2	1000	1000 *2	
Pulse-pair Resolution			70	10	70	10	ns
Output Pulse Width			30	Depends on count rate	30	Depends on count rate	ns
Output Pulse Height *4		Min.	3.0	2.0	3.0	2.0	V
		Typ.	3.6	2.2	3.6	2.2	
Recommended Load Resistance			50				Ω
Signal Output Logic			Positive logic				—
Operating Ambient Temperature *5			+5 to +40				°C
Storage Temperature *5			-20 to +50				°C
Weight			75				g

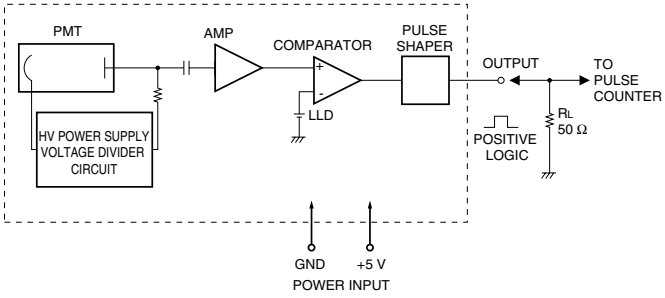
*1: Random pulse, at 10 % count loss
*2: Output count will be decreased to 1/4 after the prescaler.
*3: After 30 minutes storage in darkness
*4: With input voltage +5 V, Load resistance 50 Ω and Coaxial cable RG-174/U (450 mm)
*5: No condensation

Characteristics (Count sensitivity, Dark count)

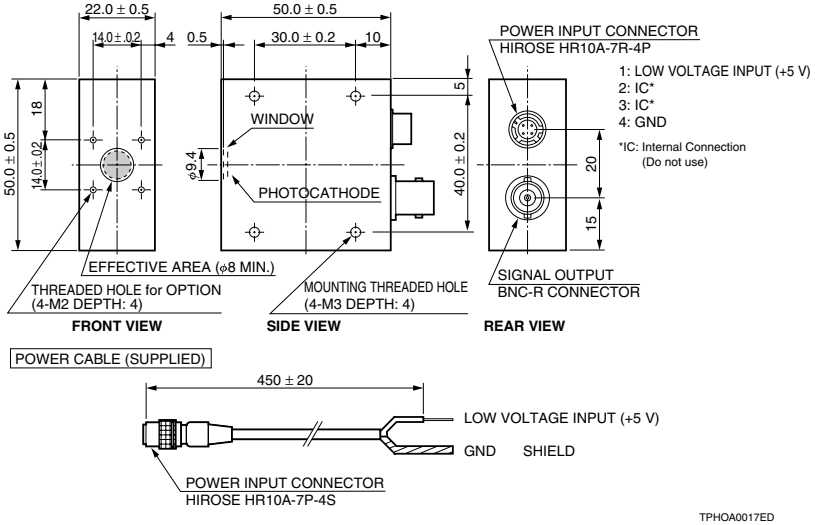




Block Diagram



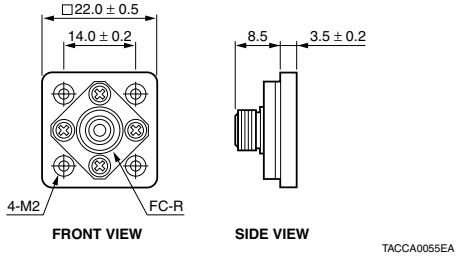
Dimensional Outlines (Unit: mm)



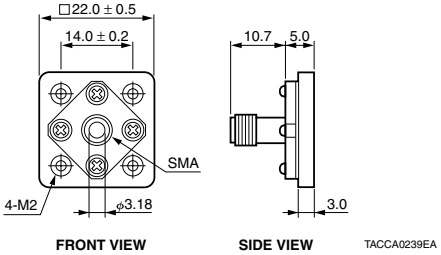
Options

(Optical Fiber Adapter) (Unit: mm)

E5776 (FC Type)



E5776-51 (SMA Type)



Metal package PMT with Cooler

Photon Counting Head H7421 Series

Heatsink with fan (A7423) sold separately

The H7421 series are photon counting head devices containing a metal package photomultiplier tube having a GaAsP/GaAs photocathode and a thermoelectric cooler. The thermoelectric cooler reduces thermal noise generated from the photocathode which also offers a high quantum efficiency, allowing measurement to be made with a good S/N ratio even at very low light levels.
The H7421-40 has high sensitivity on wavelength from 300 nm to 720 nm. The H7421-50 is sensitive over a wide spectral range from 380 nm to 890 nm. The photomultiplier tube is maintained at a constant temperature by monitoring the output from a thermistor installed near the photomultiplier tube and regulating the current to the thermoelectric cooler.

Product Variations

Type No.	Spectral Response	Features
H7421-40	300 nm to 720 nm	GaAsP photocathode, QE 40 % at peak wavelength
H7421-50	380 nm to 890 nm	GaAs photocathode, QE 12 % at peak wavelength

Specifications

Parameter		H7421-40	H7421-50	Unit
Input Voltage		+4.5 to +5.5		V
Max. Input Voltage for Main Unit		+6		V
Max. Input Current for Main Unit		50		mA
Max. Input Voltage for Thermoelectric Cooler		2.6		V
Max. Input Current for Thermoelectric Cooler		2.2		A
Effective Area		ϕ5		mm
Peak Sensitivity Wavelength		580	800	nm
Count Sensitivity		7.8×10^5	3.9×10^5	$s^{-1} \cdot pW^{-1}$
Count Linearity *1		1.5×10^6	1.5×10^6	s^{-1}
Dark Count *2 *3	Typ.	100	125	s^{-1}
	Max.	300	375	
Pulse-pair Resolution		70		ns
Output Pulse Width		30		ns
Output Pulse Height *4	Min.	3.0		V
	Typ.	3.6		
Recommended Load Resistance		50		Ω
Signal Output Logic		Positive logic		—
Operating Ambient Temperature *5		+5 to +35		°C
Storage Temperature *5		-20 to +50		°C
Weight		340		g

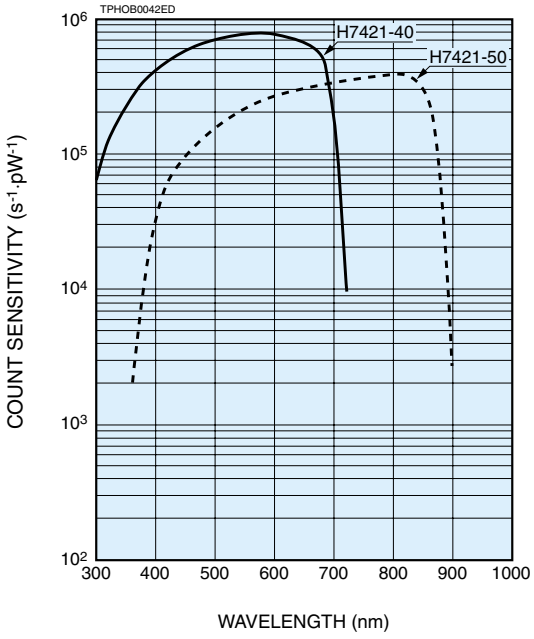
*1: Random pulse, at 10 % count loss
*2: PMT setting temperature 0 °C, used with C8137, M9011 and A7432
*3: After 30 minutes storage in darkness
*4: With input voltage +5 V, Load resistance 50 Ω and Coaxial cable RG-174/U (450 mm)
*5: No condensation

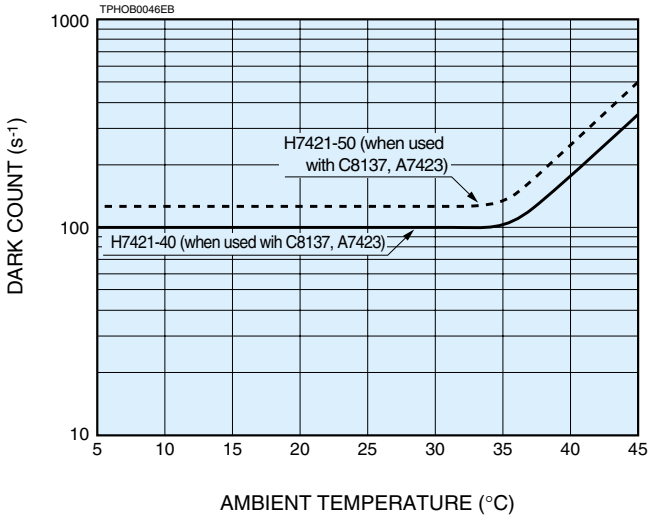
Cooling Specifications

Parameter	H7421-40 / H7421-50	Unit
Cooling Method	Thermoelectric cooling	—
Max. Cooling Temperature (ΔT) *6	35	°C
Cooling Time *6	Approx. 5	min

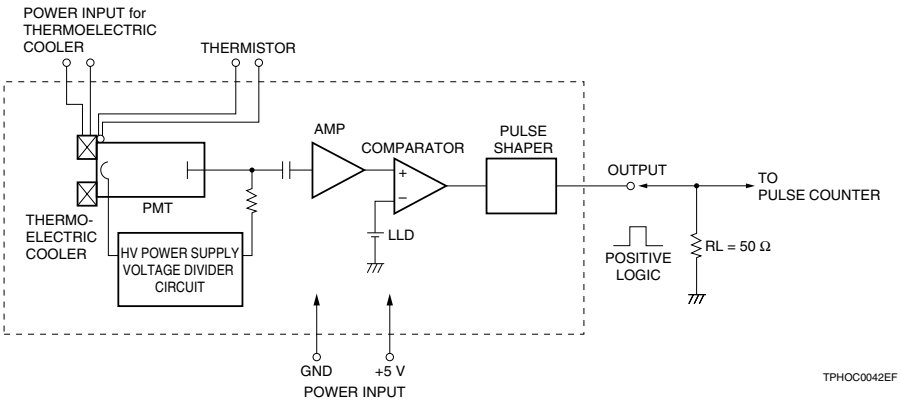
*6: Input current to thermoelectric cooler = 2 A

Characteristics (Count sensitivity, Dark count)

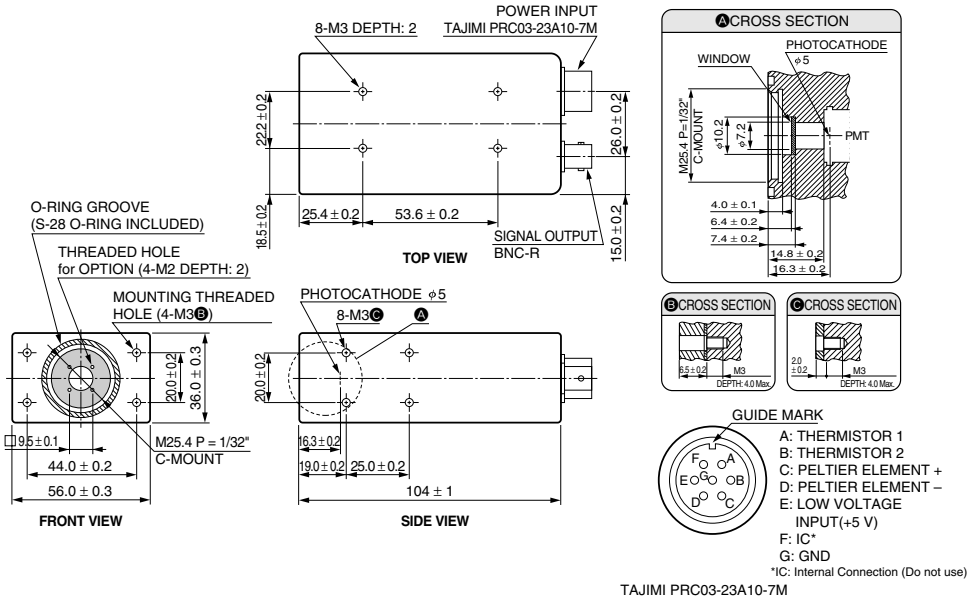




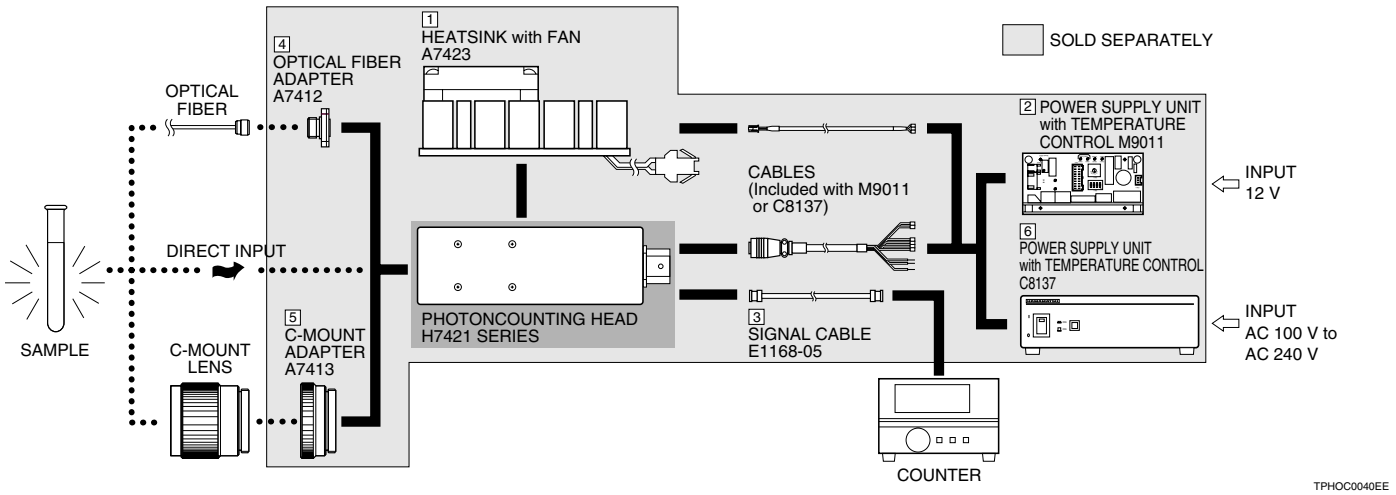
Block Diagram



Dimensional Outlines (Unit: mm)



Options for H7421 Series



● Heatsink with Fan A7423

The temperature of the H7421 outer case rises due to the thermoelectric cooler housed in the case. The A7423 heatsink efficiently radiates away this heat to prevent a temperature rise in the H7421. The A7423 can be easily installed onto the H7421 with four M3 screws. Apply a coat of heat conductive grease onto the joint surface shared by the H7421 and A7423.

Parameter		Value	Unit
Input Voltage		12	V
Input Current	During Lock	140	mA
	During Operation	90	mA
Operating Voltage		10.2 to 13.8	V
Weight		120	g

● Power Supply Unit with Temperature Control M9011

The M9011 is an on-board type power supply unit.
By just connecting to 12 V supply, the M9011 provides power necessary to operate the H7421 series. The M9011 also controls the thermoelectric cooler in the H7421 series so that the output and noise can be maintained at constant levels even when the ambient temperature changes. The thermoelectric cooler and PMT operation can be controlled from an external device by connecting it to the I/O connector on the M9011.

Parameter		Description / Value	Unit
Max. Cooling Temperature (ΔT)		35	°C
Input Voltage		12	V
Max. Input Current		1.2	A
Max. Power Consumption		15.8	V·A
Main Circuit Output Voltage		5	V
Max. Output Current for Thermoelectric Cooler		2.2	A
Output Voltage for Fan		12	V
Control Signal Input Voltage	Thermoelectric Cooler	Non-insulated TTL level input	—
	PMT	Non-insulated TTL level input	
	Fan	Non-insulated TTL level input	
Error Signal Output Voltage	Thermoelectric Cooler	Non-insulated TTL level output	—
LED Output	PMT	5	V
	Error	5	
Setting Cooling Temperature		0	°C
Weight (excluding cables)		120	g

● Signal Cable E1168-05

This signal cable comes attached to a BNC connector for easily connecting the H7421 to external equipment.

● Optical Fiber Adapter (FC Type) A7412

The A7412 is an FC type optical fiber connector that attaches to the light input window of the H7421. The A7412 can easily be secured in place with four M2 screws.

● C-mount Adapter A7413

The A7413 mount adapter is used when a C-mount lens protruding 4 mm or more from the flange-back must be installed onto the H7421.

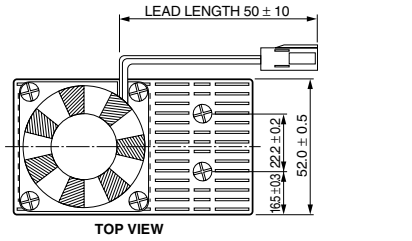
● Power Supply Unit with Temperature Control C8137

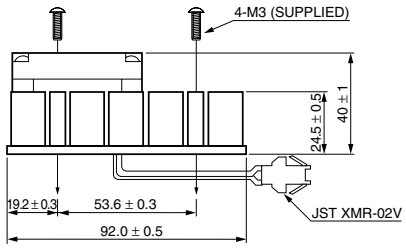
The C8137 is a power supply unit with a temperature control function. Just connecting to an AC source of 100 V to 240 V generates the output voltages for the thermoelectric cooler and the A7423 fan, needed for operating the H7421. The photomultiplier tube temperature can be maintained to 0 °C by monitoring the thermistor and regulating the output current for the thermoelectric cooler.

Parameter	Value	Unit
Max. Cooling Temperature (ΔT)	35	°C
Setting Cooling Temperature (preset at factory)	0	°C
AC Input Voltage	100 to 240	V
Input Voltage Frequency	50/60	Hz
Power Consumption	30	V·A
Main Circuit Output Voltage	+5	V
Max. Current for Thermoelectric Cooler	2.2	A
Output Voltage for Fan	12	V
Weight	1	kg

Options (Unit: mm)

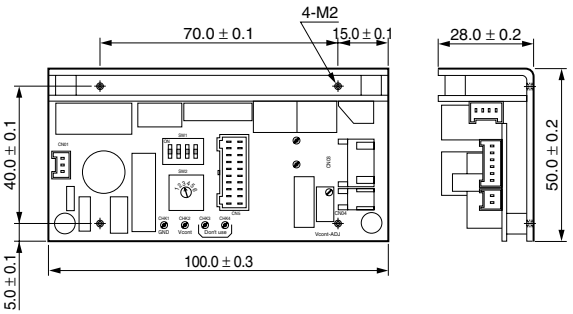
1 Heatsink with Fan A7423

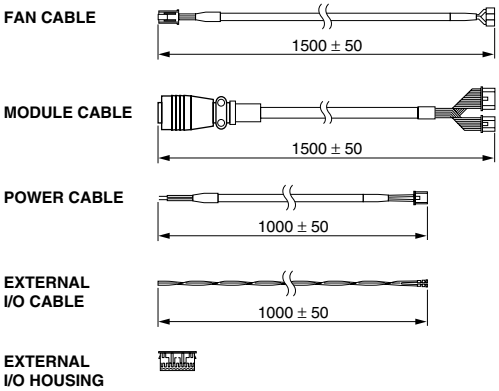




TACCA0188ED

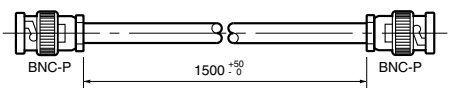
2 Power Supply Unit with Temperature Control M9011





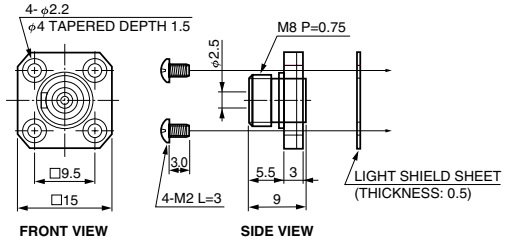
TACCA0252EA

3 Signal Cable E1168-05



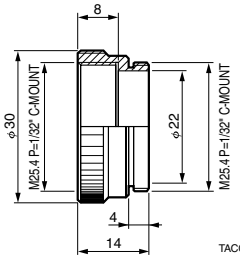
TACCA0148EA

4 Optical Fiber Adapter (FC Type) A7412



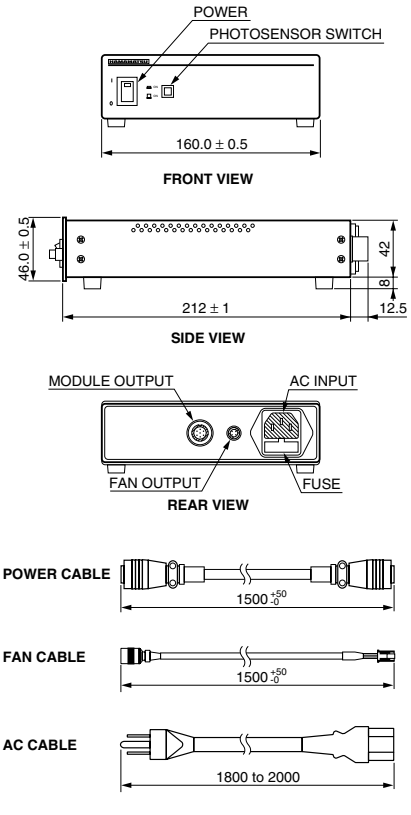
TACCA0190EB

5 C-mount Adapter A7413



TACCA0191EA

6 Power Supply Unit with Temperature Control C8137



TACCA0237EB

Side-on PMT

Photon Counting Head H8259 Series

The H8259 series are photon counting head devices containing a 28-mm (1-1/8") diameter side-on photomultiplier tube, high-speed photon counting circuit, and high-voltage power supply circuit. Three types of photomultiplier tubes are provided as standard lineups to meet various needs for spectral response range. The photomultiplier tube sensitive in the near IR region usually has a large dark count due to thermal noise but high S/N measurements can be obtained since a low-noise photomultiplier tube is selected. The high voltage supply for photomultiplier tube and the discrimination level are preset to optimum values, allowing photon counting measurement by just connecting a +5 V supply. An electronic gate circuit (shutter circuit) is also included to eliminate extraneous light such as excitation light from the measurement.

Product Variations

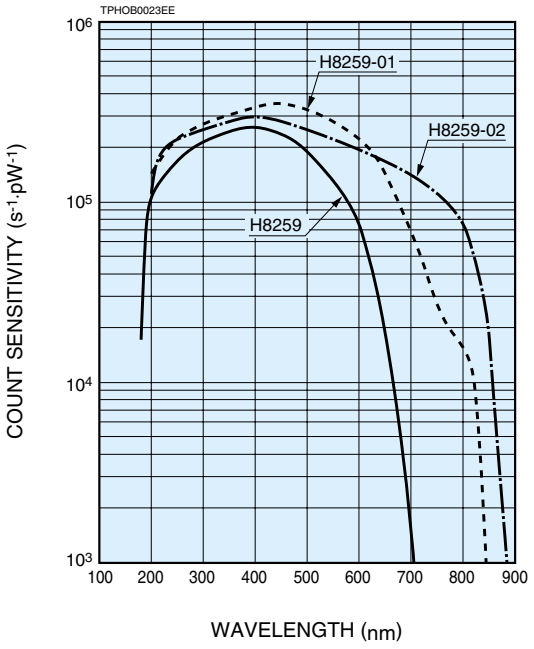
Type No.	Spectral Response	Features
H8259	185 nm to 680 nm	Low dark count in UV to visible range
H8259-01	185 nm to 850 nm	Low dark count in UV to near IR range
H8259-02	185 nm to 900 nm	High sensitivity and low dark count in UV to near IR range

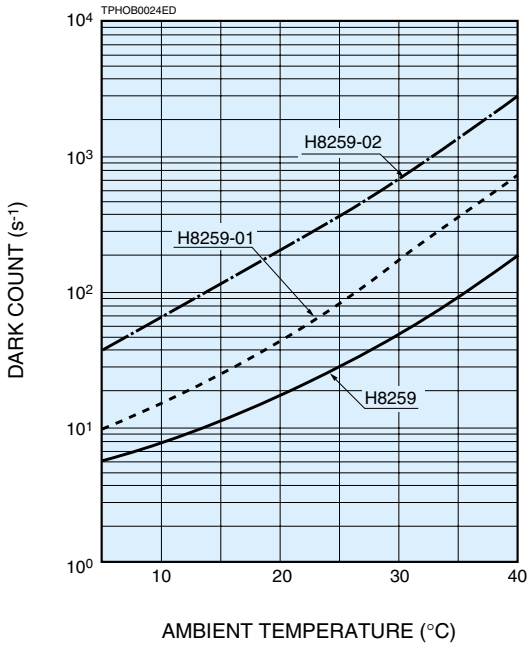
Specifications

Parameter				H8259	H8259-01	H8259-02	Unit
Input Voltage				+4.5 to +5.5			V
Max. Input Voltage				+6			V
Max. Input Current				80			mA
Effective Area				4×20		4×6	mm
Peak Sensitivity Wavelength				400	430	400	nm
Count Sensitivity		Typ.	300 nm	2.1×10^5	2.7×10^5	2.5×10^5	$s^{-1} \cdot pW^{-1}$
			400 nm	2.6×10^5	3.3×10^5	3.0×10^5	
			500 nm	1.9×10^5	3.2×10^5	2.5×10^5	
			600 nm	7.5×10^4	2.3×10^5	2.0×10^5	
			700 nm	1.5×10^3	6.8×10^4	1.4×10^5	
			800 nm	—	1.6×10^4	7.5×10^4	
			900 nm	—	—	3.0×10^2	
Count Linearity *1				2.5×10^6			s^{-1}
Dark Count *2			Typ.	30	80	400	s^{-1}
			Max.	80	200	800	
Gate	Mode			Normally ON			—
	Switching Ratio			1/1000			—
	Gate Input	Level		C-MOS (High level: +3.5 V to +5.0 V)			—
		Input Impedance		1			kΩ
		Gate Width (FWHM)		50 µs to ∞			—
		Repetition Rate	Max.	10			kHz
Pulse-pair Resolution				35			ns
Output Pulse Width				30			ns
Output Pulse Height *3			Min.	2.0			V
			Typ.	2.2			
Recommended Load Resistance				50			Ω
Signal Output Logic				Positive logic			—
Operating Ambient Temperature *4				+5 to +40			°C
Storage Temperature *4				-20 to +50			°C
Weight				220			g

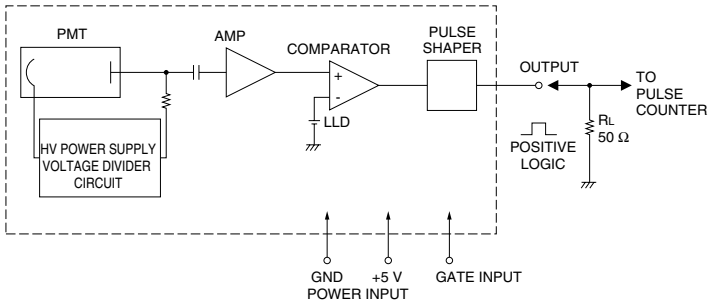
*1: Random pulse, at 10 % count loss *2: After 30 minutes storage in darkness
*3: With input voltage +5 V, Load resistance 50 Ω and Coaxial cable RG-174/U (450 mm) *4: No condensation

Characteristics (Count sensitivity, Dark count)



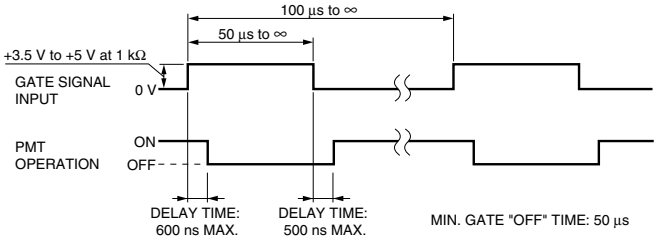


Block Diagram



TPHOC0023EC

Gate Timing Chart



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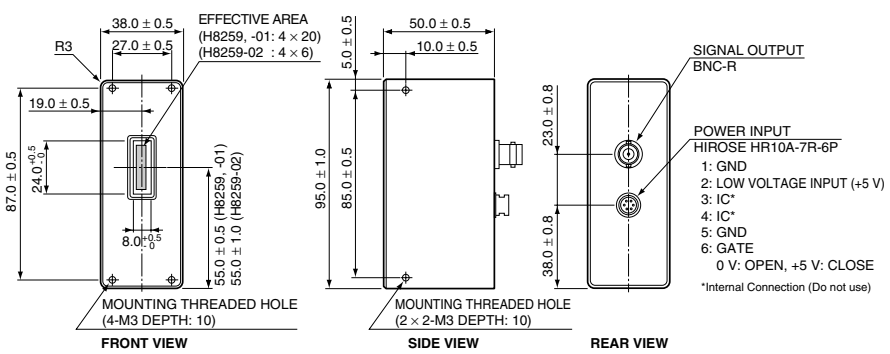
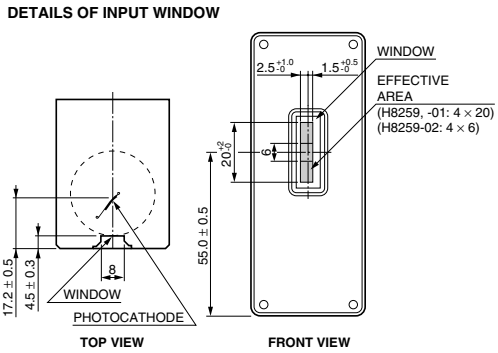
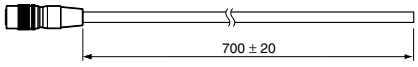
Dimensional Outlines (Unit: mm)





TPMOC0167EA

Power cable with connector (HIROSE HR10A-7P-6S) is supplied with the H8259 series



BLACK : GND
RED : LOW VOLTAGE INPUT (+5 V)
GREEN: GATE SIGNAL INPUT
(0 V or GND: OPEN, +5 V: CLOSE)
WHITE : NC
BLUE : NC

TPHOA0027EB

Compact Head-on PMT

Photon Counting Head H7828 Series

The H7828 series are photon counting head devices using a 19-mm (3/4") diameter head-on photomultiplier tube, high-speed photon counting circuit, and high-voltage power supply circuit. The high voltage supply for photomultiplier tube and the discrimination level are preset to optimum values, allowing photon counting measurement by just connecting a +5 V supply. Despite its compact size, the effective photosensitive area is as large as 15 mm in diameter, so the incident light can be collected very efficiently. Compared to other PMT modules, the H7828 series devices have higher resistance to vibration and shock, making them suitable for portable or mobile measurement equipment. Two types of photomultiplier tubes with different spectral response characteristics are provided for measurement in the visible range or visible to near IR range.

Product Variations

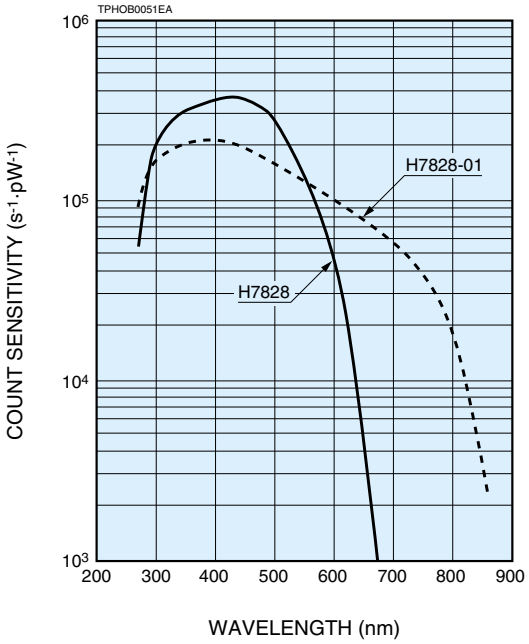
Type No.	Spectral Response	Features
H7828	300 nm to 650 nm	For visible range
H7828-01	300 nm to 850 nm	For visible to near IR range

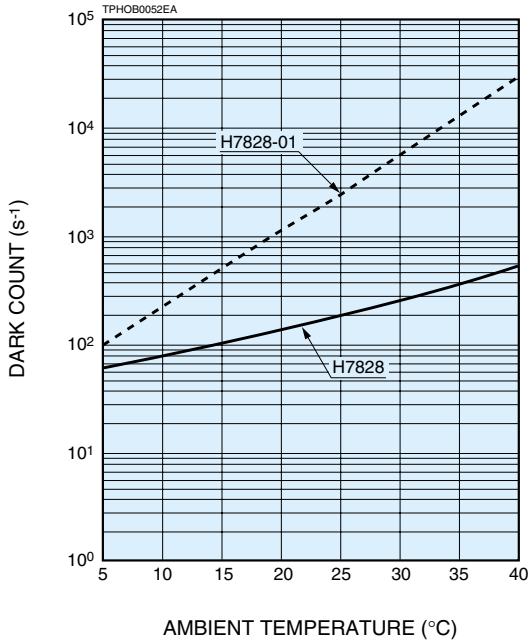
Specifications

Parameter			H7828	H7828-01	Unit
Input Voltage			+4.5 to +5.5		V
Max. Input Voltage			+6		V
Max. Input Current			60		mA
Effective Area			ϕ15		mm
Peak Sensitivity Wavelength			420	380	nm
Count Sensitivity	Typ.	300 nm	2.1×10^5	1.7×10^5	$s^{-1} \cdot pW^{-1}$
		400 nm	3.6×10^5	2.1×10^5	
		500 nm	2.8×10^5	1.6×10^5	
		600 nm	5.0×10^4	1.0×10^5	
		700 nm	—	5.9×10^4	
Count Linearity *1			1.5×10^6		s^{-1}
Dark Count *2		Typ.	200	2000	s^{-1}
		Max.	500	3500	
Pulse-pair Resolution			70		ns
Output Pulse Width			30		ns
Output Pulse Height *3		Min.	3.0		V
		Typ.	3.5		
Recommended Load Resistance			50		Ω
Signal Output Logic			Positive logic		—
Operating Ambient Temperature *4			+5 to +40		°C
Storage Temperature *4			-20 to +50		°C
Weight			70		g

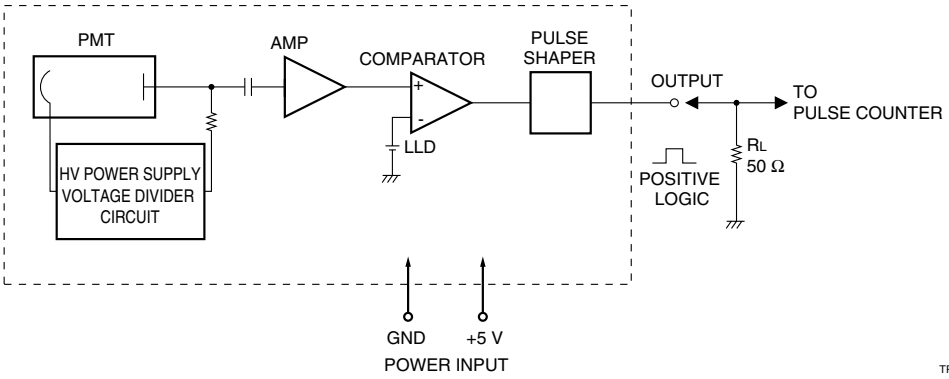
*1: Random pulse, at 10 % count loss
*2: After 30 minutes storage in darkness
*3: With input voltage +5 V, Load resistance 50 Ω and Coaxial cable RG-174/U (450 mm)
*4: No condensation

Characteristics (Count sensitivity, Dark count)

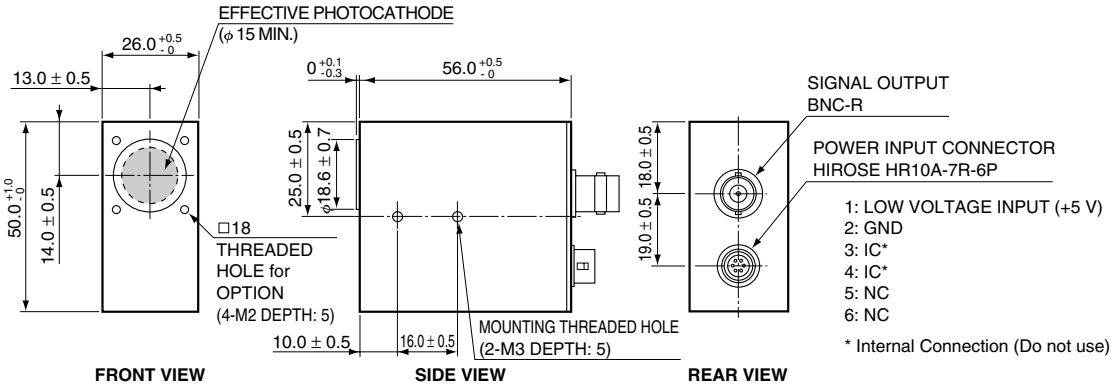




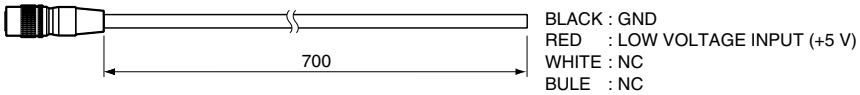
Block Diagram



Dimensional Outlines (Unit: mm)



Power cable with connector (HIROSE HR10A-7P-6S) is supplied with H7828 series

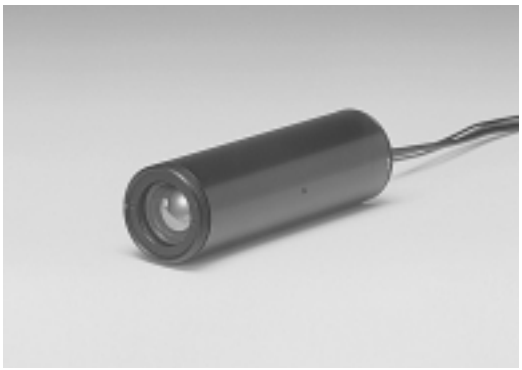


BLACK : GND
RED : LOW VOLTAGE INPUT (+5 V)
WHITE : NC
BULE : NC
GREEN: NC

TPHOA0028EC

Head-on PMT

Photon Counting Head H7360 Series



The H7360 series are wide sensitive area photon counting head device containing a 25-mm (1") diameter head-on photomultiplier tube, high-voltage power supply circuit and photon counting circuit. Since those circuits are designed for wide band, the H7360 series can operate at a high count rate. The high voltage supply for photomultiplier tube and the discriminator level are preset to optimum values so that photon counting can be performed just by connecting a +5 V supply and a pulse counter.

The H7360-01 is of low noise, the H7360-02 has enhanced detection efficiency in the visible range, and the H7360-03 covers sensitivity from the visible to near infrared.

A mount flange (E6264) is provided as an option for easy installation to measurement equipment.

Product Variations

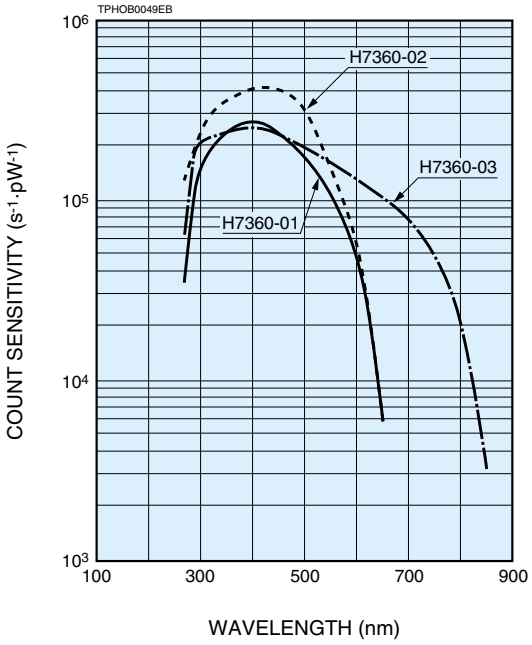
Type No.	Spectral Response	Features
H7360-01	300 nm to 650 nm	Low noise
H7360-02		High detection efficiency
H7360-03	300 nm to 850 nm	For visible to near IR range

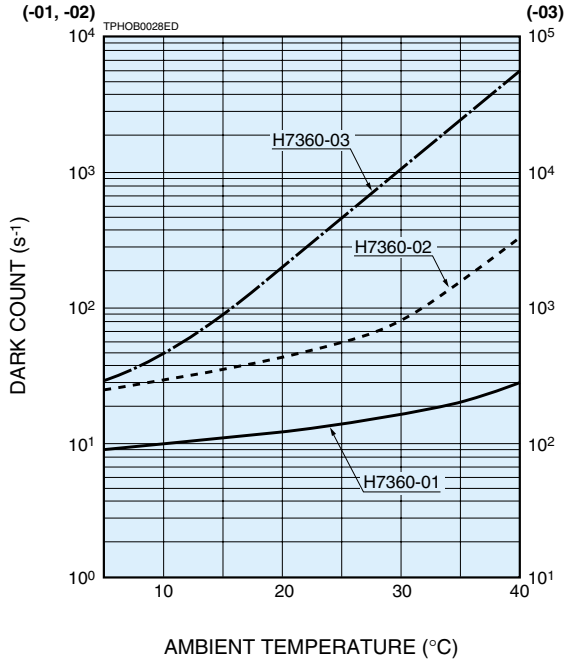
Specifications

Parameter			H7360 Series			Unit
Suffix			-01	-02	-03	
Input Voltage			+4.75 to +5.25			V
Max. Input Voltage			+6			V
Max. Input Current			140			mA
Effective Area			ϕ22			mm
Peak Sensitivity Wavelength			375	420	420	nm
Count Sensitivity	Typ.	300 nm	1.4×10^5	2.3×10^5	2.1×10^5	$s^{-1} \cdot pW^{-1}$
		400 nm	2.7×10^5	4.1×10^5	2.5×10^5	
		500 nm	1.7×10^5	3.4×10^5	2.0×10^5	
		600 nm	4.6×10^4	5.7×10^4	1.3×10^5	
		700 nm	—	—	7.8×10^4	
Count Linearity *1			6.0×10^6			s^{-1}
Dark Count *2		Typ.	15	60	5000	s^{-1}
		Max.	80	300	15000	
Pulse-pair Resolution			18			ns
Output Pulse Width			9			ns
Output Pulse Height *3		Typ.	3			V
Recommended Load Resistance			50			Ω
Signal Output Logic			Positive logic			—
Operating Ambient Temperature *4			+5 to +40			°C
Storage Temperature *4			-20 to +50			°C
Weight		Main Body	140			g
		Mount Flange	25			

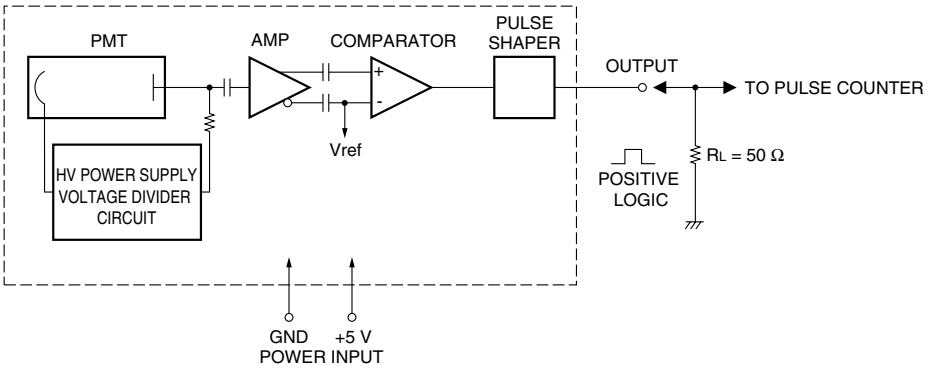
*1: Random pulse, at 10 % count loss
*2: After 30 minutes storage in darkness
*3: With input voltage +5 V, Load resistance 50 Ω
*4: No condensation

Characteristics (Count sensitivity, Dark count)

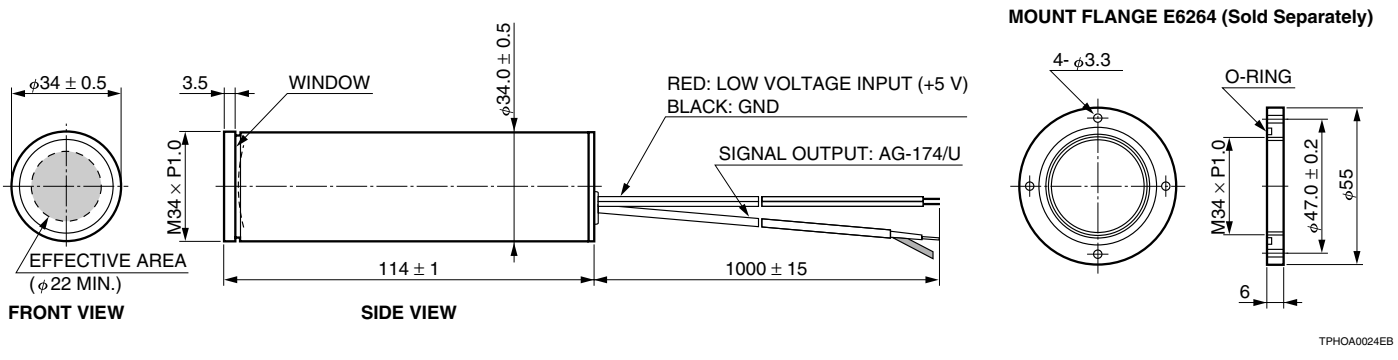




Block Diagram

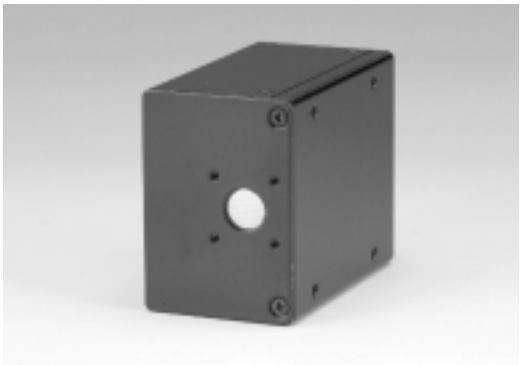


Dimensional Outlines (Unit: mm)



Metal Package PMT

Photon Counting Head H7467 Series



The H7467 series are photon counting head designed for photon counting by simply connecting to a PC (personal computer). The H7467 houses a metal package photomultiplier tube, high-voltage power supply circuit, photon counting circuit, 20-bit counter and microprocessor in a compact package. Data transfer, measurement time and other necessary adjustments are controlled by commands from the PC through the RS-232C interface. The photon counting circuit discrimination level and the high voltage supply for photomultiplier tube are preadjusted to optimum values prior to shipment so that the H7467 can be easily operated by simply supplying +5 V.

Product Variations

Type No.	Spectral Response	Features
H7467	300 nm to 650 nm	For visible range
H7467-01	300 nm to 850 nm	For visible to near IR range

Specifications

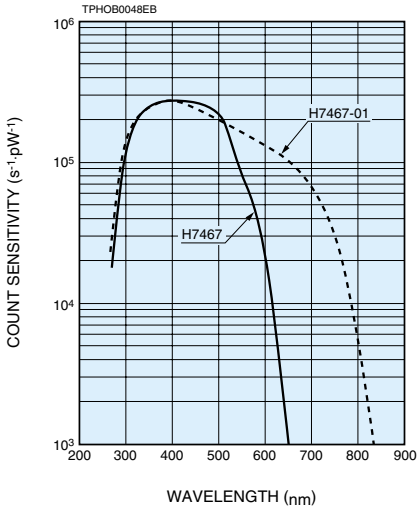
Parameter			H7467	H7467-01	Unit
Input Voltage			+4.5 to +5.5		V
Max. Input Voltage			6		V
Max. Input Current			180		mA
Effective Area			ϕ8		mm
Peak Sensitivity Wavelength			420	400	nm
Count Sensitivity	Typ.	300 nm	1.2×10^5	1.2×10^5	$s^{-1} \cdot pW^{-1}$
		400 nm	2.7×10^5	2.7×10^5	
		500 nm	2.2×10^5	2.0×10^5	
		600 nm	2.1×10^4	1.4×10^5	
		700 nm	—	6.7×10^4	
Count Linearity *1			1.5×10^6		s^{-1}
Dark Count *2		Typ.	50	600	s^{-1}
		Max.	100	1000	
Pulse-pair Resolution			70		ns
Interface			RS-232C, 9600 baud, Parity none, 8 data bit, 1 stop bit		—
Integration Time			10 to 10 000 (10 Step)		ms
Operating Ambient Temperature *3			+5 to +40		°C
Storage Temperature *3			-20 to +50		°C
Weight			120		g

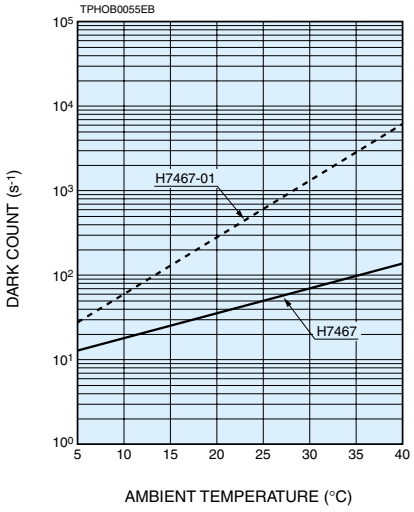
*1: Random pulse, at 10 % count loss
*2: After 30 minutes storage in darkness
*3: No condensation

Command List

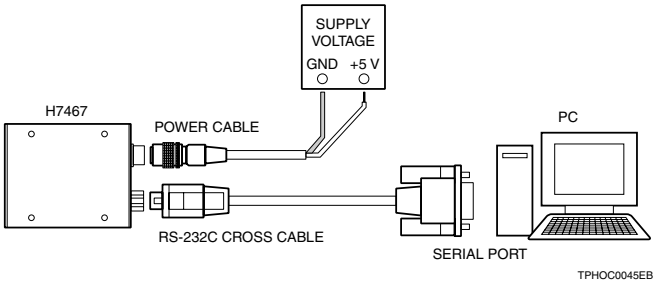
Action	Send Command	Explanation
The Integration time settng	&H80XXXXXXXX	"XXXXXXXX" is the integration time in milliseconds.
The Measurement number setting	&H81XXXXXXXX	"XXXXXXXX" is the measurement number. Generally set to "00000001"
Start Command	&H8400000001	—
Stop Command	&H8400000000	—

Characteristic (Count sensitivity)

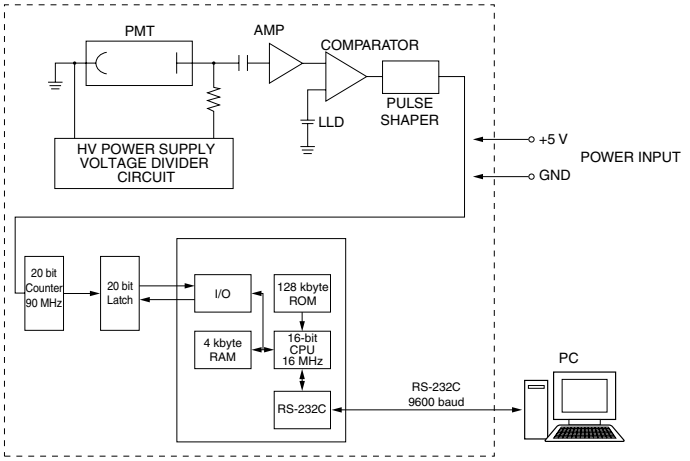




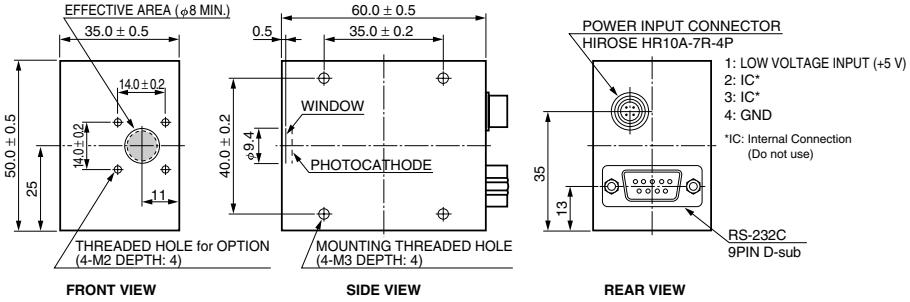
Connection Diagram

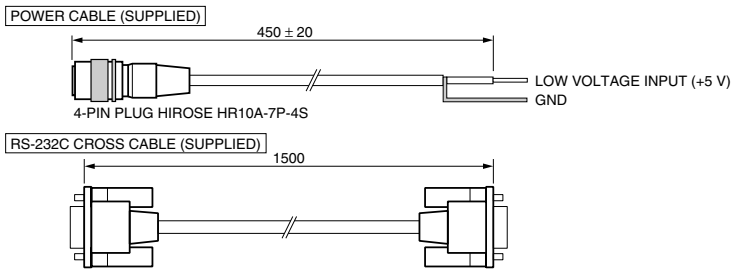


Block Diagram



Dimensional Outlines (Unit: mm)





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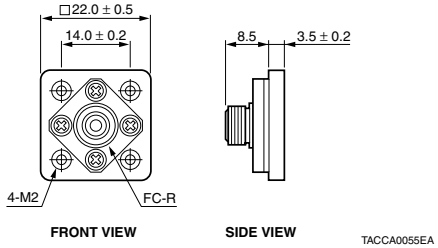
Options

(Optical Fiber Adapter) (Unit: mm)

E5776 (FC Type)



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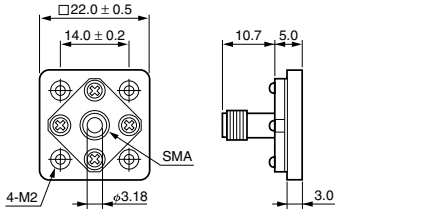
E5776-51 (SMA Type)



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Head-on PMT

Photon Counting Head H9319 Series

The H9319 series photon counting heads are designed to perform photon counting by just connecting to a PC. The H9319 series includes a 25-mm (1") diameter head-on photomultiplier tube, photon counting circuit, high-voltage power supply circuit, counter and microprocessor. Data transfer, measurement time and other necessary adjustments can be controlled by commands from the PC through the RS-232C interface.

Since the H9319 series performs linearity correction by the internal microprocessor, it provides excellent count linearity within a range of ±1 % at 2×10^7 s^{-1}.

Product Variations

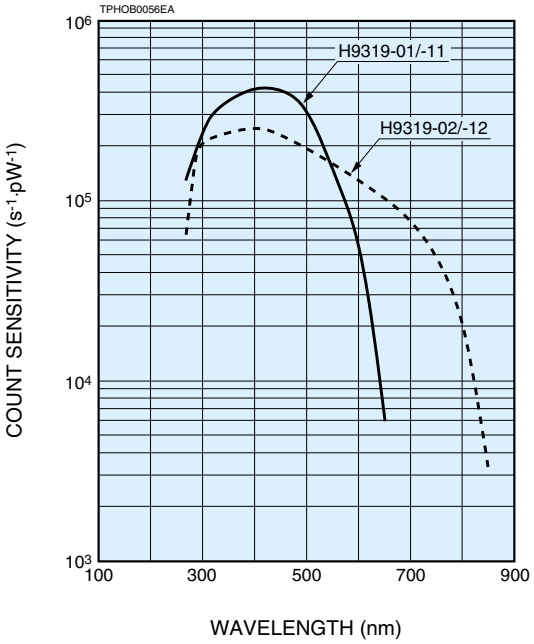
Type No.	Spectral Response	Sample Program	Prescaler
H9319-01	300 nm to 650 nm	yes	1/4
H9319-11		no	1/4
H9319-02	300 nm to 850 nm	yes	1/4
H9319-12		no	1/4

Specifications

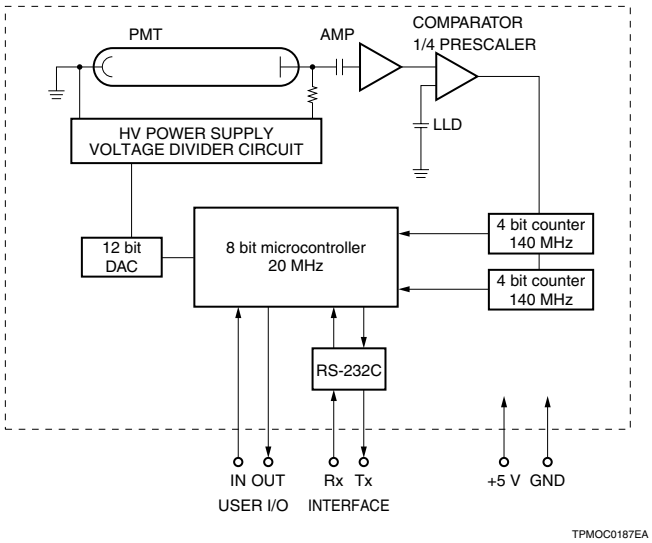
Parameter			H9319 Series				Unit
Suffix			-01	-11	-02	-12	—
Input Voltage			+4.75 to +5.25				V
Max. Input Voltage			+6				V
Max. Input Current			60				mA
Effective Area			ϕ22				mm
Peak Sensitivity Wavelength			420				nm
Count Sensitivity	Typ.	300 nm	2.3×10^5		2.1×10^5		$s^{-1} \cdot pW^{-1}$
		400 nm	4.1×10^5		2.5×10^5		
		500 nm	3.4×10^5		2.0×10^5		
		600 nm	5.7×10^4		1.3×10^5		
		700 nm	—		7.8×10^4		
Count Linearity *1			2×10^7				s^{-1}
Dark Count *2		Typ.	150		10 000		s^{-1}
		Max.	300		15 000		
PMT Operating Voltage Range			+300 to +1200				V
Integration Time			10 to 1000				ms
Settling Time			1 *3				s
			5 *4				s
Input Signal (External Trigger Input) *5			TTL level signal				—
Output Signal (User Line Output) *6			TTL level signal				—
Interface			RS-232C, 9600 baud, Parity none, 8 data bit, 1 stop bit				—
Operating Ambient Temperature *7			+5 to +50				°C
Storage Temperature *7			-20 to +50				°C
Weight *8			280				g

*1: Random pulse, ±1 %
*2: After 30 minutes storage in darkness
*3: The time required for the output to reach a stable level following a change in the control voltage from 500 V to 1000 V in darkness
*4: The time required for the output to reach a stable level following a change in the control voltage from 1000 V to 500 V in darkness
*5: Selectable ECR mode or LCR mode (refer to command list)
*6: Controllable by RS-232C command
*7: No condensation
*8: Main body: Approx. 180 g

Characteristic (Count sensitivity)



Block Diagram

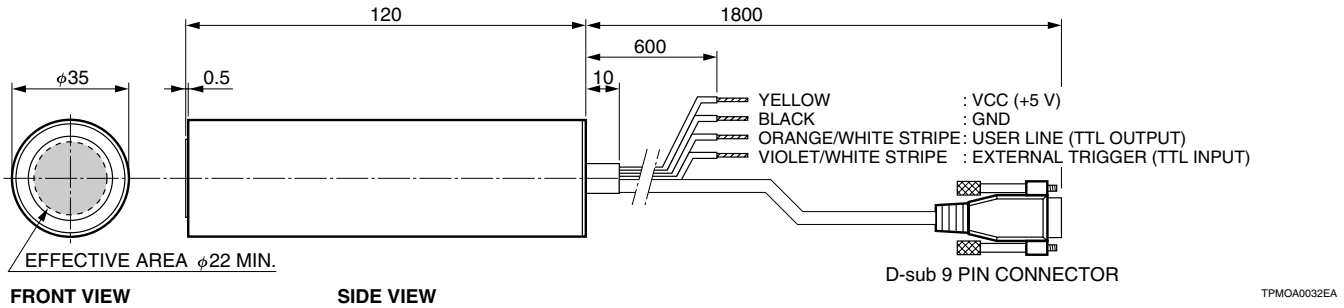


Command List

Action	Command *9	Explanation	Argument	Response *10
Set the Integration Time	P#CR	Set the number of 10 msec intervals to sum. Same as integration time for 1 reading.	1 to 100	VA, BC, BA
Set the Sequence of Readings	R#CR	Set sequence of readings, where each reading uses the integration time set with the P command.	1 to 255	VA, BC, BA
Set the PMT Input Voltage	V##CR	Change the high voltage applied to the tube.	300 to 1200	VA, BC, BA
	DCR	Re-set the default high voltage to the tube	—	VA, BC
Set the Output of the User Line	O#CR	Set the output of the user digital output line. 0: Low level output 1: High level output	0 or 1	VA, BC, BA
Start the Reading Sequence	SCR	Start the reading sequence	—	4 byte/reading
	CCR	Start a continuous reading process. Will continue indefinitely until a STOP character (CR) is sent.	—	4 byte/reading
	ECR	Start a reading sequence for each positive-edge TTL transition applied to the purple stripe user line.	—	4 byte/reading
	LCR	Start a reading sequence for each positive-level TTL transition applied to the purple stripe user line.	—	4 byte/reading

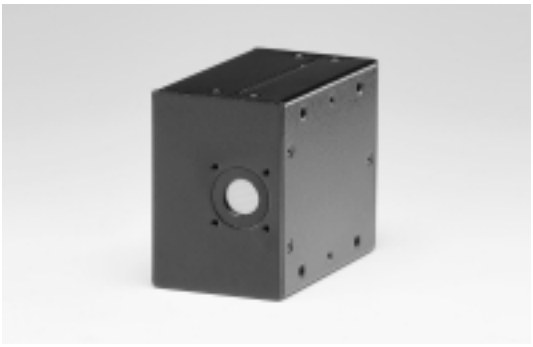
*9: The Response acknowledgment is returned having two bytes.
*10: VA: valid command, BC: bad command, BA: bad argument

Dimensional Outlines (Unit: mm)



Metal Package PMT

PMT Module with Gate Function H10304 Series



The H10304 series is a PMT module that allows high-speed gate operation at a high repetition rate. The combination of built-in metal package PMT and gate circuit makes this module compact yet still provides excellent characteristics: 100 ns minimum gate width, 100 kHz repetition rate. This module also contains a high-voltage power supply so that PMT gain can be varied by simply adjusting the control voltage. The internal protection monitor issues an error signal if high-intensity light enters the module.
A pulse generator C10149 (option) is also provided for gating the H10304.

Product Variations

H10304–A–B

A

Suffix	Spectral Response
-00	300 nm to 650 nm
-01	300 nm to 850 nm
-02	300 nm to 880 nm
-03	185 nm to 650 nm
-04	185 nm to 850 nm
-06	185 nm to 880 nm
-20	300 nm to 920 nm

B

Suffix	Spectral Response
NN	Normally ON Type
NF	Normally OFF Type

The suffix -06 type (synthetic silica window) has higher sensitivity than the -03 type below 300 nm wavelength range.

Specifications

Parameter	H10304 Series	Unit
Input Voltage	+14.5 to +15.5	V
Max. Input Voltage	+16	V
Max. Input Current	100	mA
Max. Surge Current	300	mA
Max. Control Voltage	+1.0 (Input impedance: 10 kΩ)	V
Recommended Control Voltage Adjustment Range	+0.25 to +0.9	V
Effective Area	φ8	mm
Pulse Linearity *1	30	mA
Max. Output Signal Current	100	μA
Operating Ambient Temperature *2	+5 to +45	°C
Storage Temperature *2	-20 to +50	°C
Weight	Approx. 120	g

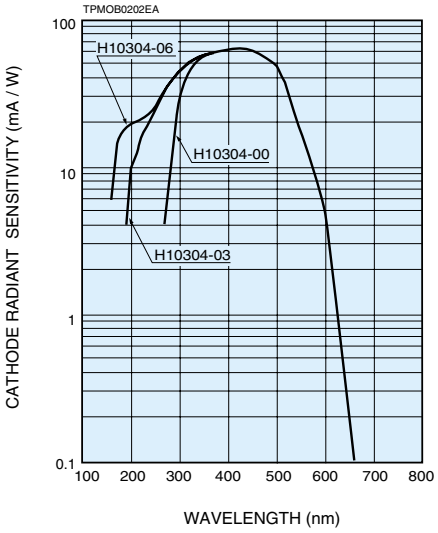
Parameter			H10304 Series					Unit
Suffix			-00	-03, -06	-01, -04	-02	-20	—
Cathode	Luminous Sensitivity	Min.	40	40	80	200	350	μA/lm
		Typ.	70	70	150	250	500	
	Radiant Sensitivity *3	Typ.	62	62	60	58	78	mA/W
Anode	Luminous Sensitivity	Min.	10	10	15	25	35	A/lm
		Typ.	50	50	75	125	250	
	Dark Current *4	Typ.	0.2	0.2	0.4	2	2	nA
		Max.	2	2	4	20	20	
Time Response *1	Rise Time	Typ.	0.78					ns
	Transit Time	Typ.	5.4					ns
	TTS	Typ.	230					ps

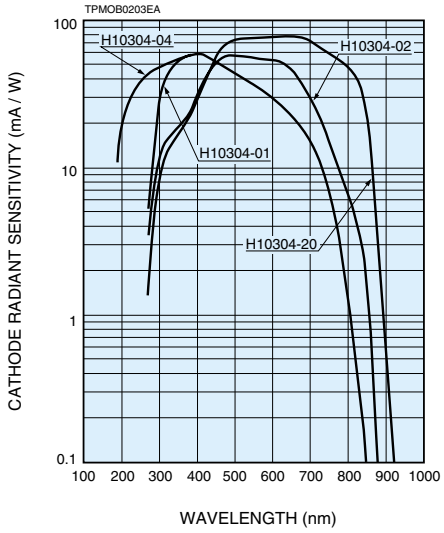
*1: Control voltage = +0.8 V
*2: No condensation
*3: Measured at the peak sensitivity wavelength
*4: Measured when photomultiplier tube operation is ON. After 30 minutes storage in darkness

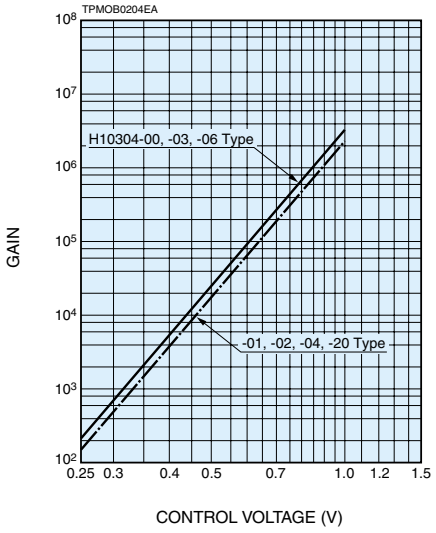
Parameter			H10304-A-NN	H10304-A-NF	Unit
Gate Mode	Mode		Normally ON	Normally OFF	—
	Gate Width (FWHM)		100 ns to ∞		—
	Rise Time		8	70	ns
	Fall Time		70	8	ns
	Repetition Rate	Max.	10		kHz
	Switching Ratio		10^7		—
	Switching Noise *5	Max.	15		mV
	Delay Time	Max.	80	180	ns
	Gate Jitter	Max.	1		ns
Gate Signal Input	Level		C-MOS (High level: +3.5 V to +5 V)		—
	Pulse Width		20 ns to ∞	200 ns to ∞	—
Sensitivity Adjustment Range			1: 10^4		—
Ripple Noise *1 *6 (peak to peak)			3		mV
Settling Time *7			0.1		s

*5: Load resistance 50 Ω, peak to peak
*6: Cable RG-174/U, Cable length 450 mm, Load resistance = 1 MΩ, Load capacitance = 22 pF
*7: 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.

Characteristics (Cathode radiant sensitivity, Gain)

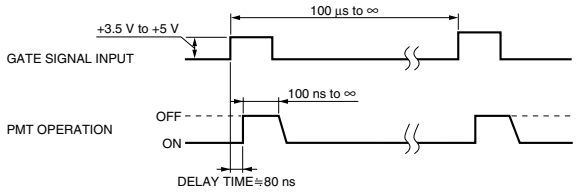




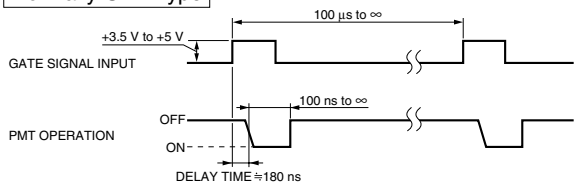


Gate Timing Chart

Normally ON Type



Normally OFF Type



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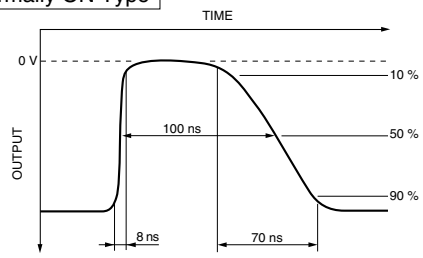
Output Examples

Normally ON Type



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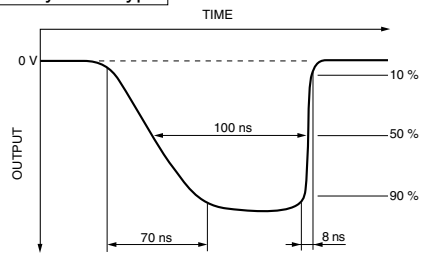
Normally OFF Type



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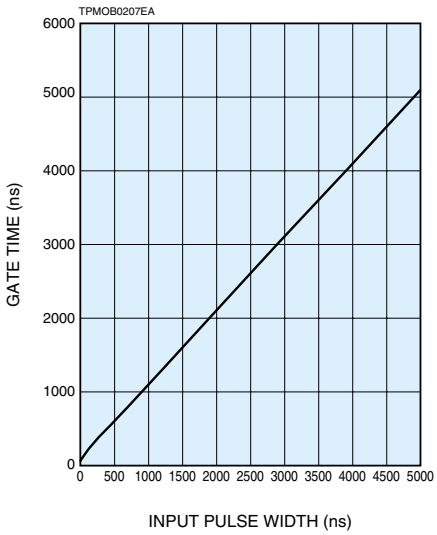
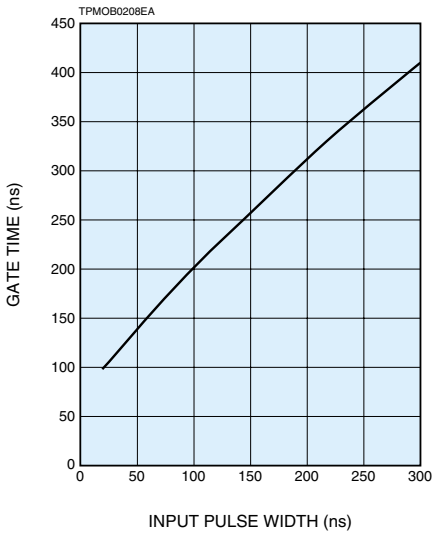
Gate Time Characteristics

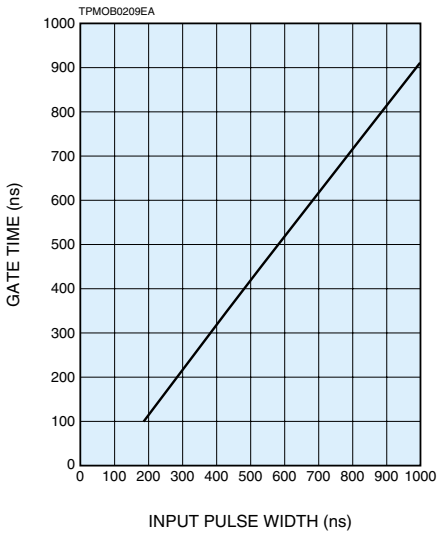
Normally ON Type



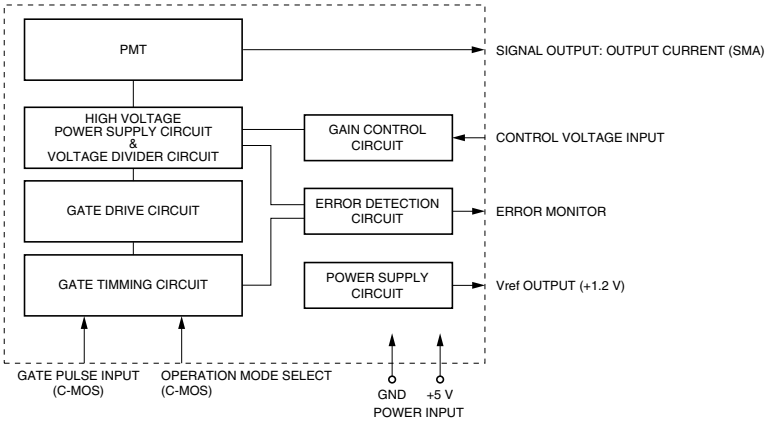
Normally ON Type closeup



Normally OFF Type



Block Diagram



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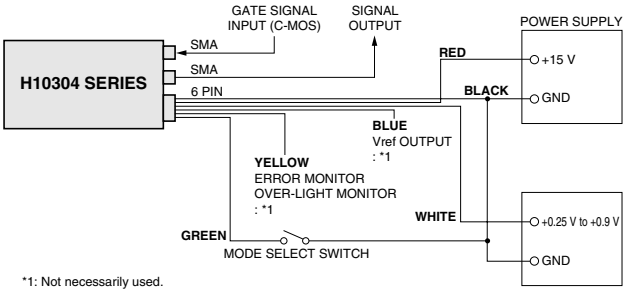
Sensitivity Adjustment Method

Voltage Programming



*1: Not necessarily used.

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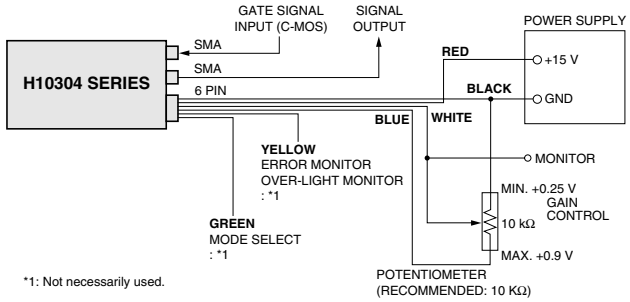
Resistance Programming



*1: Not necessarily used.

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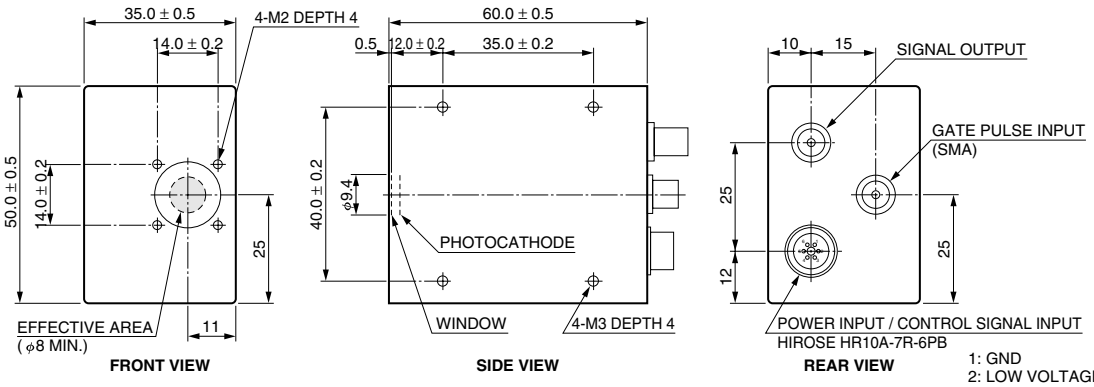
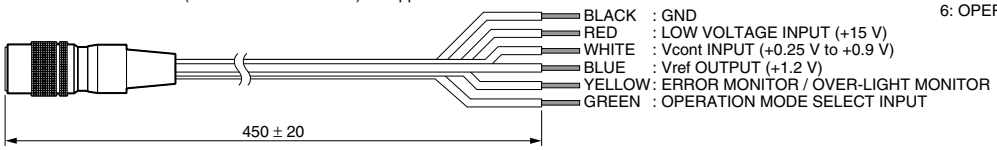
Dimensional Outlines (Unit: mm)



1: GND
2: LOW VOLTAGE INPUT (+15 V)
3: Vcont INPUT (+0.25 V to +0.9 V)
4: Vref OUTPUT (+1.2 V)
5: ERROR MONITOR / OVER-LIGHT MONITOR
6: OPERATION MODE SELECT INPUT

Power cable with connector (HIROSE HR10A-7P-6S) is supplied with H10304



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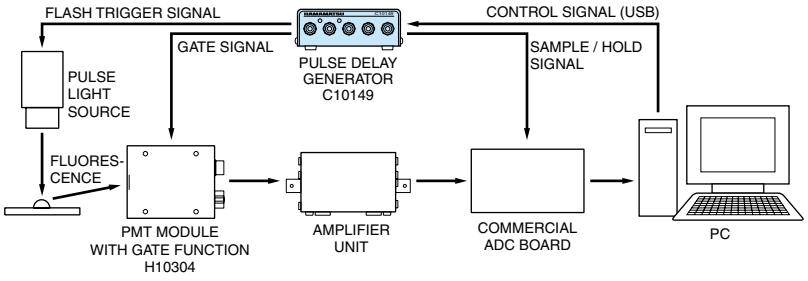
Option

PULSE DELAY GENERATOR C10149

The C10149 can provide the gate (shutter) timing required to operate the H10304. Up to 3 independent channels are available for pulsed output. One channel can be output in burst mode.
The C10149 connects to a PC (personal computer) through a USB port, PC is used to control, set and supply power to the C10149.

Connecting Example



TAPPC0162EA

Related Products

Power Supply for PMT Modules C7169

The C7169 is a power supply unit for driving photosensor modules. Both drive voltages and control voltages can be supplied from this one unit.

Applicable products:

H5773/H5783/H6779/H6780 Series, H5784 Series
H9305 Series, H9306/H9307 Series
H7732 Series, H7826 Series, H7827 Series, H8249 Series
H9656 Series

Parameter		Description / Value	Unit
Output Voltage		±15	V
Output Current	Max.	0.3 (+15 V), 0.2 (-15 V)	A
Control Voltage (variable voltage range) *1		0 to +1.2	V
AC Input Voltage		100 to 240	V
Input Power Frequency		50/60	Hz
Operating Ambient Temperature *2		+5 to +50	°C
Storage Temperature *2		-20 to+50	°C
Output Connector		Binding post	—
Dimensional Outlines (W × H × D)		147 × 61 × 200	mm
Weight		Approx.1.2	kg

*1: Adjust within the recommended control voltage range for the photosensor module being used.
*2: No condensation

Amplifier Units

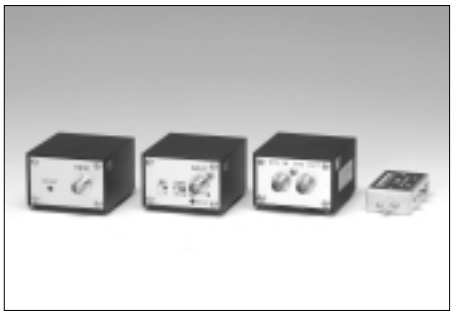
These are amplifier units for photomultiplier tubes and current output type PMT modules.

C7319: Switchable between 2 frequency bandwidths and 3 current-to-voltage conversion factor. Ideal for applications requiring low noise and high gain.

C6438: Wide bandwidth from DC to 50 MHz and gain of 20 dB. (-01 type is 54 dB)

C9663: Wide bandwidth from DC to 150 MHz and gain of 38 dB.

C5594: High cut off frequency of 1.5 GHz. Faithfully amplifies high-speed output pulses. The input/output connector can be selected from the SMA or BNC types.



▲ From left: C9663, C7319, C6438, C5594-44

Parameter		C7319	C6438	C6438-01	C9663	C5594-44 *6	Unit
Frequency Bandwidth (-3 dB)		DC to 20 kHz or DC to 200 kHz (switchable)*1	DC to 50 MHz	DC to 50 MHz	DC to 150 MHz	50 kHz to 1.5 GHz	—
Voltage Gain		— *2	20 ± 3 *4 (Approx. 10 times)	54 ± 3 *4 (Approx. 500 times)	38 *4 (Approx. 80 times)	36 *4 (Approx. 63 times)	dB
Current-to-Voltage Conversion Factor		0.1 V/µA, 1 V/µA or 10 V/µA (switchable)	0.5 mV/µA *5	25 mV/µA *5	4 mV/µA *5	3.15 mV/µA *5	—
Amplifier Input (output)		±Current (inverted)	±Voltage (non-inverted)	±Voltage (non-inverted)	±Voltage (non-inverted)	±Voltage (non-inverted)	—
Input Impedance		— *2	50	50	50	50	Ω
Recommended Load Resistance		—	50	50	50	50	Ω
Output Signal Voltage	Max.	±13 *3	±1 *4	±1 *4	±1.4 *4	+0.8, -2.5 *4	V
Connector	Input	BNC-R	BNC-R	BNC-R	BNC-R	BNC-R	—
	Output	BNC-R	BNC-R	BNC-R	BNC-R	BNC-R	—
	Power	DIN (6-pin)	DIN (6-pin)	DIN (6-pin)	DIN (6-pin)	—	—
Input Voltage		±5 to ±15	±5	±5	±5	+12 to +16	V
Input Current	Max.	±16	±55	±80	±80	+95	mA
Dimensions (W × H × D)		60 × 43.2 × 65	60 × 43.2 × 65	60 × 43.2 × 65	60 × 43.2 × 65	54 × 17 × 33	mm
Weight		Approx.170	Approx.160	Approx.160	Approx.180	Approx.80	g

*1: Frequency bandwidth is limited to DC to 100 kHz at conversion coefficient of 10 V/µA. *2: C7319 is current input type.
*3: At ±15 V Supply voltage and 10 kΩ load resistance. *4: At 50 Ω load resistance.
*5: Value after current-to-voltage conversion by input impedance. *6: Contact our sales office for other connectors for C5594.

Photon Counting Unit C9744

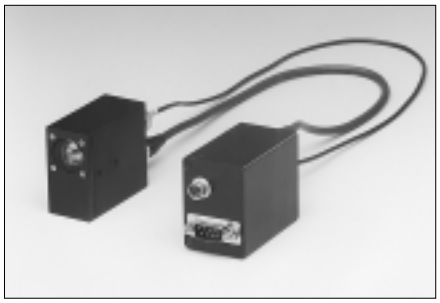
Photon counting unit is designed to convert single photoelectron pulses from a photomultiplier tube into 5 V digital signals by use of the built-in amplifier and discriminator circuits. Photon counting with a high S/N ratio can be performed by simply connecting a counter to the output of the photon counting unit.
The C9744 uses a high-speed electronic circuit that allows measurement with an excellent output linearity up to 10^7 s^{-1}. The C9744 also has a prescaler (division by 10) eliminating the need for a high-speed counter.

Parameter		Description / Value		Unit
Input Impedance		50		Ω
Discrimination Level (input conversion)		-0.4 to -16		mV
Required PMT Gain		3×10^6		—
Prescaler		÷1	÷10	—
Count Linearity	÷1	4×10^6		s^{-1}
	÷10	1×10^7		
Pulse-pair Resolution	÷1	25		ns
	÷10	10		
Output Pulse		CMOS 5 V, POSITIVE LOGIC		—
Output Pulse Width	÷1	10		ns
	÷10	Depends on count rate		—
Supply Voltage		+5.0 V ± 0.2 V, 130 mA / -5.0 V ± 0.2 V, 50 mA		—
Connector	Input	BNC-R		—
	Output	BNC-R		—
	Power	DIN (6-pin) *2		—
Dimensions (W × H × D)		90 × 32 × 140		mm
Operating Ambient Temperature *1		0 to +50		°C
Storage Temperature *1		-15 to +60		°C
Weight		Approx. 250		g

*1: No condensation *2: Supplied with a cable (1.5 m) attached to the mating plug.

Data Acquisition Unit C8908

The C8908 data acquisition unit have a signal processing circuit that converts analog signals of a PMT module into digital data for output to a PC (personal conputer). Integration time, number of reading and photomultiplier tube gain can be controlled from the PC. The C8908 also provide output voltage necessary to operate a PMT module, making device setup and connection easier.



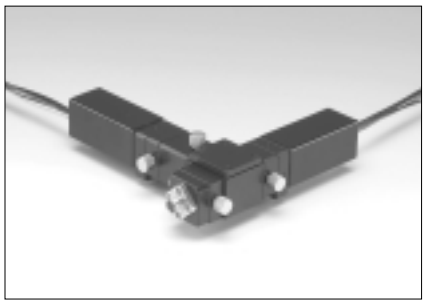
Left: Photosensor module ▶ (sold separately)
Right: C8908

Parameter	Description / Value	Unit
Configuration	Charge amp + ADC + CPU + interface	—
Pulse-pair Resolution	—	ns
ADC Resolution	12	bit
Interface	RS-232C	—
Integration Time	0.04 to 500	ms
Dead Time	0.01 to 500	ms
Number of Reading at Fixed Set Reading	1 to 127	—
Supply Voltage	+5	V
Accessories (supplied)	Power cable (6-pin), RS-232C cross cable	—
Applicable PMT Modules	H7826 Series, H7732 Series, H6780 Series *1, H5783 Series *1, H9305 Series *1	—

*1: We can install a signal connector (BNC-P) and a power input connector (HIROSE HR 10A-7P-6P) to the cable ends of an applicable PMT module if needed (extra charge). Please specify the type of connector when placing your order.
* : Communication commands are identical to those for the H7468.

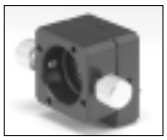
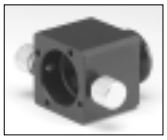
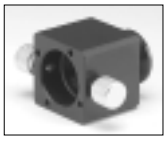
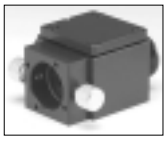
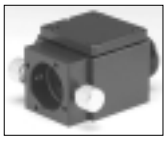
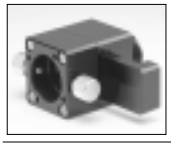
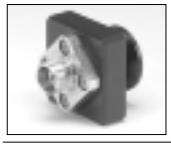
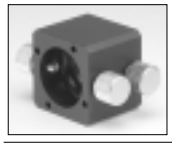
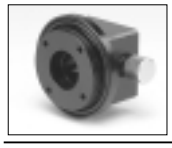
Optical Blocks for PMT Modules

The optical block is a compact unit containing optical components such as bandpass filters and dichroic mirror. Optical components are accurately arranged in angular "minutes" by high-precision machining technology. The joint section is fully light-shielded by its V shape and an O-ring. It can easily be attached to another block or removed by the thumb screw, allowing any desired combination of blocks.



▲Optical block combinations

Line Up

Picture	Type No.	Over View
	Adapter Block A10030	Adapter block for connecting each block to PMT module
	Beam Expander Block A10031	The beam expander block expands or reduces the diameter of the incident light beam (parallel light). When entering measurement light to the PMT module, it narrows a 20 mm diameter beam down to a 7 mm diameter bean. The tip of the block has a C-mount thread for connecting to another device.
	ND Filter Block A10032 Series	A neutral density (ND) filter is included in this optical block to attenuate light levels.
	Filter Block A10033 Series	This optical block contains a filter that passes only particular wavelengths. Bandpass filters and long-pass filters are available.
	Dichroic Block A10034 Series	This optical block contains a dichroic mirror that reflects particular wavelengths but transmits other wavelengths.
	Beam Splitter Block A10035	This optical block uses a cubic type half-mirror. Incident light is split into reflected and transmitted beams at a ratio of 1 to 1. **NOTE:** Light level is cut to approximately one third due to light absorption.
	Shutter Block A10036	The A10036 is a manual shutter block with a plate that is opened and closed by sliding it left and right. An O-ring is placed in this shutter block to prevent light from leaking through the gap between the block body and the plate. Light is sufficiently blocked so there will be no problem even at photon counting levels.
	Fiber Adapter Block A10037(FC) A10037-01(SMA)	The lens assembled in the block collimates the light spread from the optical fiber. Connectable to FC and SMA connector type fiber cable
	Joint Block A10038 Series	The A10038 series is a joint block for connecting one optical block to another. The joint is available in two types: MM (male-male) type and FF (female-female) type. Interposing the MM block (A10038-01) and/or FF block (A10038-02) between optical blocks allows various connections.
	C-mount Adapter Block A10039	One end of this adapter block has a C-mount (male threads) that connects to the H7421 series or H7422 series PMT module, while the other end couples to another optical block. This adapter block also connects to a commercially available device with a C-mount.

Features

- **Easy to Attach/Detach**
- **No Alignment Required**
- **Superb Light-shielding Effect**

Suitable PMT Module

H5773 / H5783 / H6779 / H6780 / H9858
H5784 / H9656 / H7155 / H7467 / H7468
H7421 / H7422 / H10304

For information on other photomultiplier tube (PMT) modules, contact our sales office.

Filter Characteristics

●ND Filter Block

Type No.	Built-in Filter	Transmittance
A10032-10	ND Filer	10 %
A10032-11		1 %

●Filter Block

Type No.	Built-in Filter	Central Wavelength / FWHM
A10033-01	Bandpass Filter	530 / 40 nm
A10033-02		610 / 40 nm
A10033-03		630 / 60 nm
A10033-04		460 / 60 nm
A10033-05		575 / 30 nm
A10033-06		700 / 60 nm

Type No.	Built-in Filter	Cut-on Wavelength
A10033-61	Longpass Filter	390 nm
A10033-62		500 nm
A10033-63		600 nm

●Dichroic Block

Type No.	Built-in Mirror	Type
A10034-01	Dichroic Mirror	DM 505
A10034-02		DM 565
A10034-03		DM 600
A10034-04		DM 660
A10034-05		DM 430
A10034-06		DM 455

Counting Unit C8855

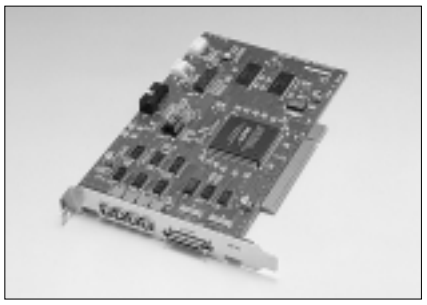
The C8855 is a counting unit with a USB interface and can be used as a photon counter when combined with a photon counting head, etc.
The counter of the C8855 includes two counter circuits (double counter method) capable of counting input signals with no dead time. The USB interface easily connects to a notebook PC allowing measurement in an even wider application field. When used with a photon counting head, the C8855 supplies power (+5 V / 200 mA) necessary to operate the photon counting head.
Since the C8855 is hot-swap compatible (plug and play compatible), it helps you set up measurement environment quickly. You can start measurement on the day the C8855 is delivered by using the sample software that supplied with the C8855.

- **Time-resolved measurement (minimum resolution: 50 μs) for monitoring chemiluminescence and biological clocks**
- **Quick measurement setups (hot-swap compatible)**
  When software such as a device driver is installed into your PC beforehand, you can start measurement by just connecting the USB cable, without restarting the PC.
- **Applicable to various measurement methods**
  The C8855 is fully controlled by DLL (dynamic link library) functions that come with the C8855.
  All information on these DLL functions is available to support software programming that handles various types of user measurement applications.

Parameter		Description / Value
Input	Number of Input Signals	1 ch
	Signal Input Level	TTL positive logic
	Signal Pulse Width	8 ns or longer
	Input Impedance	50 Ω
Counter	Counter Method	Double counter method
	Maximum Count Rate	50 MHz
	Maximum Counter Capacity	2^{32} counts/counter gate
Counter Gate	Counter Gate Mode	Internal counter gate only
	Internal Counter Gate Time	50 μs to 10 s (1, 2, 5 step)
Trigger	Trigger Method	External trigger / Software trigger
	External Trigger Signal	TTL negative logic
General Output Section		Open collector / 2 bits
Voltage Output		+5 V / 200 mA Max.
Compatible OS		Windows® 2000/XP Pro
Interface		USB (Ver. 1.1)
Supply Voltage		+7 V / 500 mA Max. (supplied from AC adapter)
Dimensions (W × H × D)		148 mm × 30 mm × 96 mm (excluding rubber feet and projecting parts)
Weight		300 g
Operating Ambient Temperature / Humidity *1		+5 °C to +45 °C / Below 80 %
Storage Temperature / Humidity *1		0 °C to +50 °C / Below 85 %
CE Marking		Conforms to the EMC directive (89/336/EEC) and the low voltage directive (73/23/EEC) of the European Union.
AC Adapter	AC Input	90 V to 264 V
	Output	7 V / 1.6 A

*1: No condensation
Supplied: CD-ROM (containing instruction manual, device driver, DLL, sample software*, etc.) USB cable, AC adapter, AC cable, power output connector
*: Sample software is configured from Lab VIEW™ of National Instruments, Inc.

Counting Board M8784



The M8784 counting board is a PCI bus add-in board type counter. The M8784 functions as a photon counter when combined with a photon counting head, etc.
The counter of the M8784 includes two counter circuits (double counter method) capable of counting input signals with no dead time. The internal memory allows pulse counting over extended periods with a high time resolution (10 μs).
A maximum of two M8784 boards can be simultaneously controlled from a PC, making it possible to perform simultaneous dual-channel measurements.
Initial setting for the M8784 is simple and easy due to PnP (plug and play). You can start measurement on the day you receive the M8784.

- **Also ideal for long-term data collection such as in biological clock monitoring** *)

  This is an ideal feature when the time needed to record count data in the memory is longer than the time needed to transfer the count data to a PC and write it into the storage medium. This allows time-resolved measurement (minimum resolution: 10 μs) over a long period of time . Memory recording time is calculated from "counter operation time × memory length".
  (Example: minimum resolution 10 μs × maximum memory length 256 000 = 2.56 s)

  *) Standard sample software may not work at some conditions depending on the combination of measuring time and time resolution. Please consult with our sales office in advance with information of your condition.

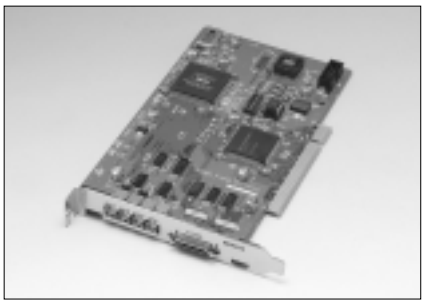
- **Time-resolved measurement of chemiluminescence (minimum resolution 10 μs)**
- **Supports different kinds of measurements**

  The M8784 is fully controlled by DLL (dynamic link library) functions that come with the M8784.
  All information on these DLL functions is available to support software programming that handles various types of user measurement applications.

Parameter		Description / Value
Input	Number of Input Signals	1 ch
	Signal Input Level	TTL positive logic
	Signal Pulse Width	8 ns or longer
	Input Impedance	50 Ω
Counter	Counter Method	Double counter method
	Maximum Count Rate	50 MHz
	Maximum Counter Capacity	2^{32} counts/counter gate
Counter Gate	Counter Gate Mode	Internal, external, START-STOP
	Internal Counter Gate Time	10 μs to 10 s (1, 2, 5 step)
	External Counter Gate Time	100 ns or longer
Trigger	Trigger Method	External trigger / Software trigger
	External Trigger Signal	TTL negative logic
Memory	Memory Method	Double memory method
	Memory Date Width	128 000 (when capacity of 2^{32} is selected) / 256 000 (when capacity of 2^{16} is selected)
	Memory Capacity	2^{32} (32 bit) / 2^{16} (16 bit)
General I/O	Input Signal	TTL negative logic / 8 bit
	Output Signal	Open collector / 8 bit
Compatible OS		Windows® 2000/XP Pro
Bus Type		PCI bus interface; conforms to Rev. 2.1
Size		PCI standard (half size)
Weight		150 g
Operating Ambient Temperature / Humidity *1		+5 °C to +45 °C / Below 80 %
Storage Temperature / Humidity *1		0 °C to +50 °C / Below 85 %
CE Marking		Conforms to the EMC directive (89/336/EEC) of the European Union.

*1: No condensation
Supplied: CD-ROM (containing instruction manual, device driver, DLL, sample software*, etc.), Signal input cable (E1168-22), General-purpose I/O connector (JAE: TXA20A-26PH1-D2P1-D1), Connection cable set (JAE: XHP-3, XHP-4)
*: Sample software is configured from Lab VIEW™ of National Instruments, Inc.

Counting Board M9003



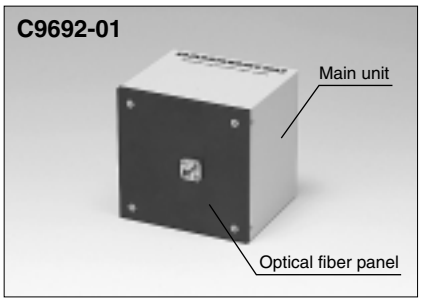
The M9003 counting board is a PCI bus add-in board counter that functions as a photon counter when used along with a Hamamatsu photon counting head.
The counter section of the M9003 has two counter circuits (double counter method) capable of counting the input signal pulses without any dead time. The counter operates in either gate counter mode or in reciprocal counter mode. Gate counter mode counts the input signal pulses only during each gate time produced by the internal oscillator. (Minimum gate time during gate counter mode is 50 ns.) Reciprocal counter mode counts the number of internal clock pulses generated between input signal pulses.
The M9003 does not have its own memory so it sends measurement data directly to the PC's main memory by DMA (direct memory access) transfer. This enables measurement of up to 64 Mbytes. External trigger signals can also be inserted into the count data as timing information.
Counting can also be performed for a predetermined number of gates starting from the input of an external trigger signal (only during gate counter mode). This allows counting periodic light emission phenomena by integrating their signals after DMA transfer.
Anyone can easily make the initial settings since the M9003 is PnP (plug and play) compatible. You can start making measurements right away after the M9003 is unpacked, by just using the sample software that comes supplied with the unit.
When used with the U9451 software for fluorescence correlation spectroscopy, the M9003 allows data acquisition and analysis in fluorescence correlation spectroscopy (FCS) and fluorescence cross-correlation spectroscopy (FCCS).

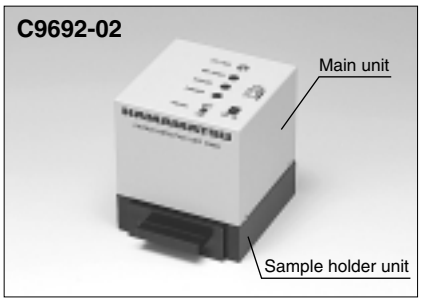
Parameter		Description / Value
Input	Number of Input Signals	2 ch
	Signal Input Level	TTL positive logic
	Signal Pulse Width	8 ns or longer
	Input Impedance (Switchable)	50 Ω (at SW ON), 100 kΩ (at SW OFF)
Counter	Counter Method	Gate mode *1 / Reciprocal mode *2
	Maximum Count Rate	50 MHz (gate mode) / 20 MHz (reciprocal mode)
	Maximum Count Capacity	2^8 / 2^{16} counts (gate mode) / 2^{31} counts (reciprocal mode)
Gate	Gate Time Resolution	50 ns to 12.7 µs
Trigger	Trigger Method	External trigger / Software trigger
	External Trigger Signal	TTL negative logic
	Trigger Signal Pulse Width	1 µs or more
	Trigger Signal Output Timing	At start of counting by software trigger
General I/O	Input Signal	TTL level signal (7 bits)
	Input Strobe Signal	TTL level signal
	Output Signal	Open collector (8 bits)
	Output Strobe Signal	Open collector
Compatible OS		Windows® 2000 / XP Pro
Bus Type		PCI bus interface; conforms to Rev 2.1.
Data Transfer Method		DMA transfer (scatter-gather method)
Data Transfer Quantity		Maximum 64 Mbytes (data quantity transferable by one DMA.)
Data Transfer Rate		40 Mbytes/sec (depends on CPU and peripherals)
Size		PCI standard (half size)
Weight		150 g
Operating Ambient Temperature / Humidity *3		+5 °C to +45 °C / Below 80 %
Storage Temperature / Humidity *3		0 °C to +45 °C / Below 85 %
CE Marking		Conforms to EMC directives (89 / 336 / EEC) of the European Union.

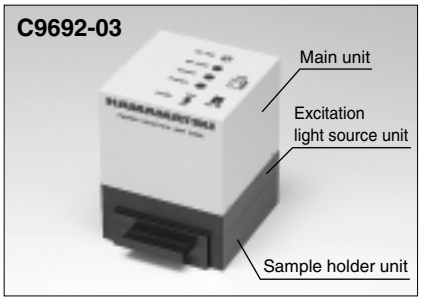
*1: Gate counter mode counts the input signal pulses only during each specified gate time.
*2: Reciprocal counter mode counts the number of internal clock pulses generated between input signal pulses.
*3: No condensation
Supplied: CD-ROM (containing instruction manual, device drivers, sample software), Signal cables
E1168-22 × 4 (LEMO-BNC: coaxial 1.5 m), Flat cable plug TXA20A-26PH1-D2P1-D1 (manufactured by JAE)

Photon Detection Unit C9692 Series

The C9692 series Photon Detection Units are photon counting units designed to make low-light measurements at single photon levels without a time-consuming measurement setup. All users need to do is prepare the sample the users want to measure and a personal computer (PC).
Three models (C9692-01/-02/-03) are available so the users can select one that best meets your application. The USB interface allows simple plug and play setup when connecting the C9692 to a PC.







Features

●Optical Fiber (FC Type) Compatible (C9692-01)

●Interlock Function (C9692-02/03)
Automatically closes optical shutter to prevent excessive light from entering PMT if sample compartment is accidentally opened during measurement.

●Built-in UV LED Excitation Light Source (C9692-03)
Light source wavelength: 375 nm
Output power: 10 mW/cm^2
Irradiation time: 0.1 to 3600 seconds

Control Software Functions

●Time-resolved Measurement
Resolves measurement time per unit time (1 ms or more) allowing measurement of various light emission patterns.

●Optical Shutter Control
Opens or closes optical shutter for excess light protection and dark current pulse measurement.

●Data Display During Measurement
Continuously transfers measurement data to PC for data monitoring.

●Measurement Data Save
Saves measurement data in Excel® format to make data analysis easier.

Specifications

Parameter			Description / Value
Detection Method			Photon counting method
Spectral Response Range			185 nm to 650 nm
Photocathode Size			16 mm × 18 mm
Maximum Count Rate			3×10^6 s^{-1}
Counter Gate Time			0.001 s to 10 s (1, 2, 5 step)
Dark Count (at 25 °C)		Typ.	50 s^{-1}
Counter Capacity			32 bits/gate
Trigger	Trigger Method		External trigger / Software trigger
	Trigger Signal		TTL negative logic
	Trigger Signal Pulse Width		100 ns or more
Input Voltage (DC)			+7 V (supplied from AC adapter)
Input Voltage (AC) to Supplied AC Adapter			100 V to 240 V (auto switchable), single phase 50 Hz/60 Hz
Operating Ambient Temperature / Humidity *1			+5 °C to +40 °C / Below 80 %
Storage Temperature / Humidity *1			0 °C to +50 °C / Below 85 %
PC and Recommended System Requirements	CPU		Intel® Pentium® 3 or higher
	CLK		1 GHz or higher
	Memory		512 MB or more
	OS		Windows® 2000/XP Pro
	Interface		USB Ver1.1

*1: No condensation
Supplied: CD-ROM (contains control software), USB cable (1.5 m), AC adapter, Cable for external trigger (1.5 m)

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 2856K. 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. The gain versus voltage curves are usually plotted on a logarithmic graph and appear as straight lines with the same slope for the same type of photomultiplier tube. This means that the gain of a photomultiplier tube can be easily found by moving in parallel with the typical gain curve.

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 μA 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 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 measurment.

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 MΩ 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.

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

PMT 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 μA, the switching ratio is 1 nA to 10 μA or expressed as $1 : 10^4$.

Internal CPU + IF Module

Counter

The H7467 (including C8907) has an internal 20-bit counter that delivers a maximum count of 1,048,575 within a specified gate time. If a longer gate time is set while the light level is relatively high, the counter is unable to count more than 1,048,575. In this case, set the gate time shorter. To reduce measurement fluctuations, averaging by the software is recommend after acquiring multiple pieces of data.

AD converter

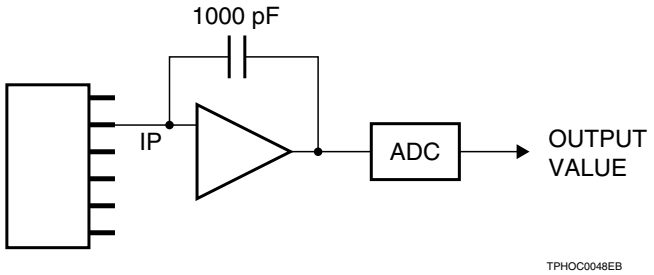
The H7468 (including C8908) uses a charge amplifier to accumulate the electric charge obtained from a photomultiplier tube during a specified sampling time, and then converts it into digital data by a 12-bit AD converter. The minimum bit corresponds to 1 mV. The photomultiplier tube average current can be calculated from the digital data as follow.

$$Ip\ (A) = 1 \times 10^{-12} \bullet Dn / Ts$$

Ip : Photomultiplier tube average current

Ts : Sampling time

Dn: Digital data (decimal value)



Precautions

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.

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.

MEMO

CUSTOMER INQUIRY SHEET

We can help you select anything from photomultiplier tube modules ideal for your particular type of measurement and application, to subassemblies with optical system and signal processing circuits designed expressly for your equipment. To help us give you exactly the right advice, please fill in the sheet below and FAX it to us or contact our sales office nearest you.

[Application]

[Measurement Conditions]

Measurement light ☐ Light absorption ☐ Reflected light ☐ Fluorescence ☐ Chemiluminescence
☐ Other ( )

Light size ( )mm in diameter or ( ) mm × ( ) mm

Wavelength ☐ Monochromatic wavelength ( ) nm
☐ Wavelength range ( ) nm to ( ) nm

Light intensity ☐ DC light : Average intensity ( ) W or ( ) photons/second
☐ Pulsed light : Peak intensity ( ) W or ( ) photons/pulse
Pulse width ( ) seconds, Repetitive rate ( ) Hz

Frequency bandwidth for measurement ( ) Hz

Dynamic range ( ) decades or Minimum light intensity ( ) W

[What kind of products do you want?]

☐ Photomultiplier tube modules
☐ Combination of the adequet PMT module and the accessories.
☐ Custom designed subassemblies
☐ Others ( )

[Sketch of product you want]

Company Name			
Division or Post		Your Name	
Address			
TEL		FAX	
Type of Business		E-mail	

HAMAMATSU

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Main Products

Electron Tubes
Photomultiplier Tubes
Light Sources
Microfocus X-ray Sources
Image Intensifiers
X-ray Image Intensifiers
Microchannel Plates
Fiber Optic Plates

Opto-semiconductors
Si Photodiodes
Photo IC
PSD
InGaAs PIN Photodiodes
Compound Semiconductor Photosensors
Image sensors
Light Emitting Diodes
Application Products and Modules
Optical Communication Devices
High Energy Particle/X-ray Detectors

Imaging and Processing Systems
Video Cameras for Measurement
Image Processing Systems
Streak Cameras
Optical Measurement Systems
Imaging and Analysis Systems

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