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PHOTOMULTIPLIER TUBE MODULES



HAMAMATSU

PHOTON IS OUR BUSINESS

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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 55 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".

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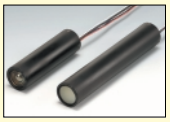
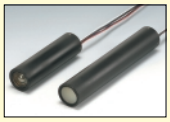
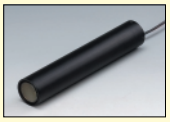
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Product Lineup

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**	 * H10720/H10721 (P.16)	 H7826 (P.26)	 H10425/H10426 (P.28, P.30)	 H9305 (P.22)	 H11461 (P.24)
With Cooler	 * H7422 (P.18)				
With Gate Function	 * H11526 (P.46)				
Photosensor Modules **Voltage Output**	 * H10722/H10723 (P.32, P.34)	 H7827 (P.40)	 H10492/H10493 (P.42, P.44)	 H9306/H9307 (P.36)	 H11462 (P.38)
Photon Counting Heads **Photon Counting**	 * H10682 (P.50)	 H7828 (P.58)	 H11123/H7360 (P.60, P.62)		
With Gate Function					 H8259 (P.56)
With Cooler	 * H7421 (P.52)				
With CPU+ Interface			 H9319 (P.64)		

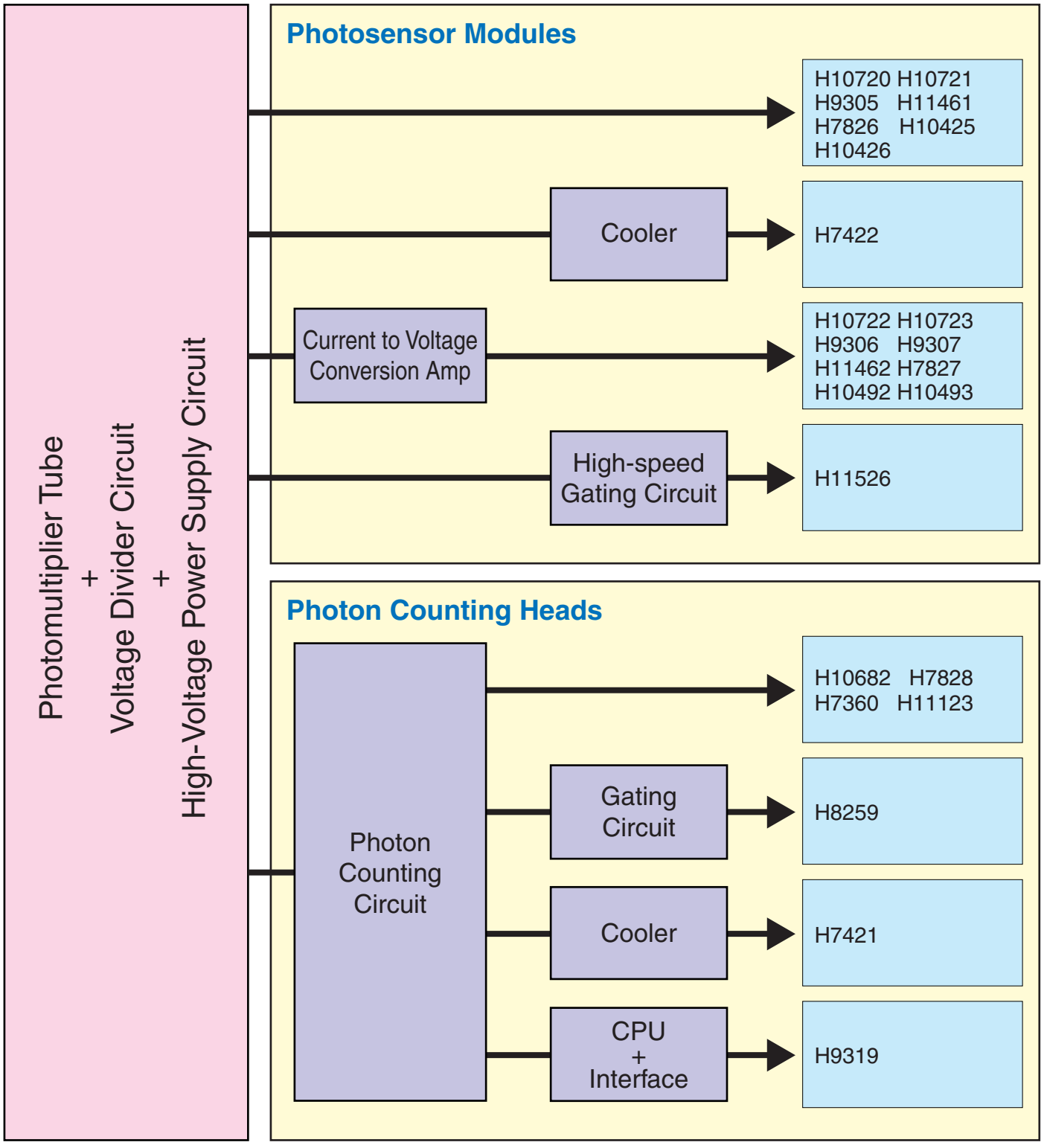
* Products are applicable to "Optical Blocks for PMT Modules" listed on page 68.

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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 H10720 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 4 ns)	Photosensitive Area (mm)	Outside Size: Cubic Ratio	Outside Size: Dimensions (mm)	Input Voltage (V)	Remarks
Current Output	H10720 Series	230 to 920	0.57	φ8	1	50 × 25 × 18	+5	Low power consumption On-board
	H10721 Series	230 to 920	0.57	φ8	1.1	22 × 22 × 50	+5	Low power consumption Cable output
	H7422 Series	300 to 890	1	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
	H11461 Series	160 to 900	2.2	4 × 20	8.0	38 × 95 × 50	+5	High gain Low power consumption
	H7826 Series	300 to 850	1.5	φ15	3.2	26 × 50 × 56	+15	For portable unit Easily couples to scintillator
	H10425 Series	300 to 850	1.5	φ22	5.1	φ35 × 120	+15	Wide sensitive area High speed response
	H10426 Series	185 to 850	4 / 15	φ25	8.2	φ35 × 192	+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	H10722 Series	230 to 920	20	φ8	1.3	22 × 22 × 60	+/-5	Feedback resistance 1 MΩ
	H10723 Series	230 to 920	200	φ8	1.4	51 × 24 × 25	+/-5	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
	H11462 Series	185 to 900	20 200	4 × 20	8.0	38 × 95 × 50	+/-5	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)
	H10492 Series	300 to 850	20 200 8000	φ22	5.1	φ35 × 120	+/-15	Feedback resistance 1 MΩ (20 kHz) Feedback resistance 100 kΩ (200 kHz, 8 MHz)
	H10493 Series	185 to 850	20 200 8000	φ25	8.2	φ35 × 192	+/-15	Feedback resistance 1 MΩ (20 kHz) Feedback resistance 100 kΩ (200 kHz, 8 MHz)

Photosensor Module

Type	Type No.	Spectral Response (200 400 600 800 nm)	Rise Time (0 1 2 3 4 ns)	Photosensitive Area (mm)	Outside Size: Cubic Ratio	Outside Size: Dimensions (mm)	Input Voltage (V)	Remarks
With gate function	H11526 Series	230 to 920	0.57	φ8	4.4	20 × 50 × 100	+15	High-speed gate Small size

Photon Counting Heads

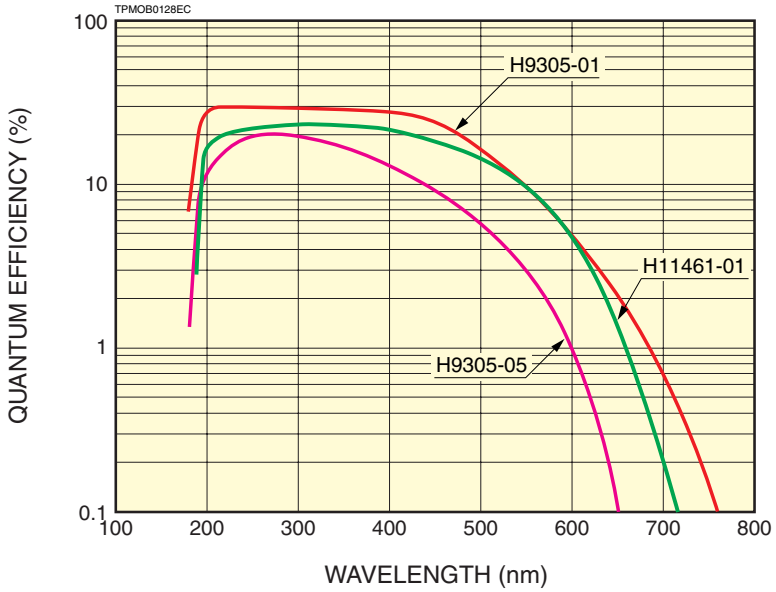
Type	Type No.	Spectral Response (200 400 600 800 nm)	Count Linearity (1 5 10 (×10⁶ s⁻¹))	Photosensitive Area (mm)	Outside Size: Cubic Ratio	Outside Size: Dimensions (mm)	Input Voltage (V)	Remarks
Photon-counting	H10682 Series	300 to 850	5	φ8	2.4	22 × 50 × 50	+5	Small size
	H7421 Series	300 to 890	1.5	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	Wide sensitive area
	H9319 Series	300 to 850	20 (with internal prescaler)	φ22	5.1	φ35 × 120	+5	Photon counting circuit+ counter+ CPU+interface
	H11123	300 to 650	5	φ25	8.2	φ35 × 192	+5	Wide sensitive area

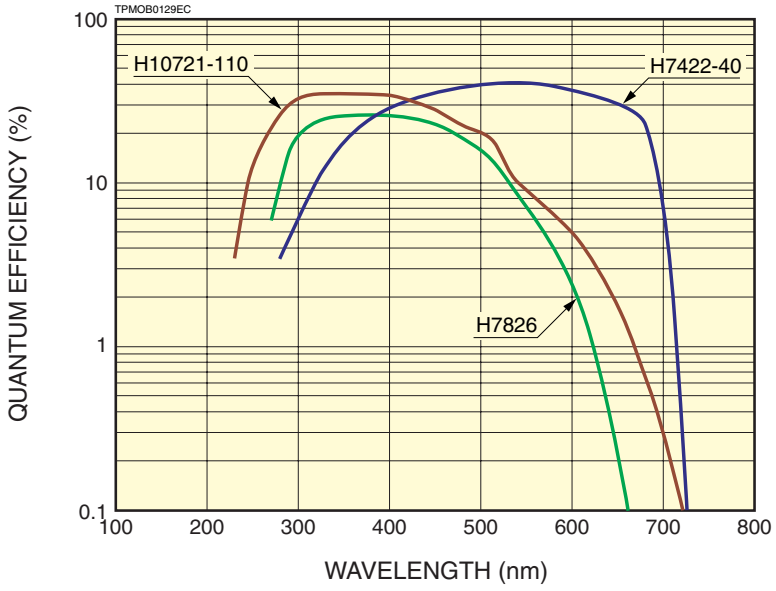
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Spectral Response

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.



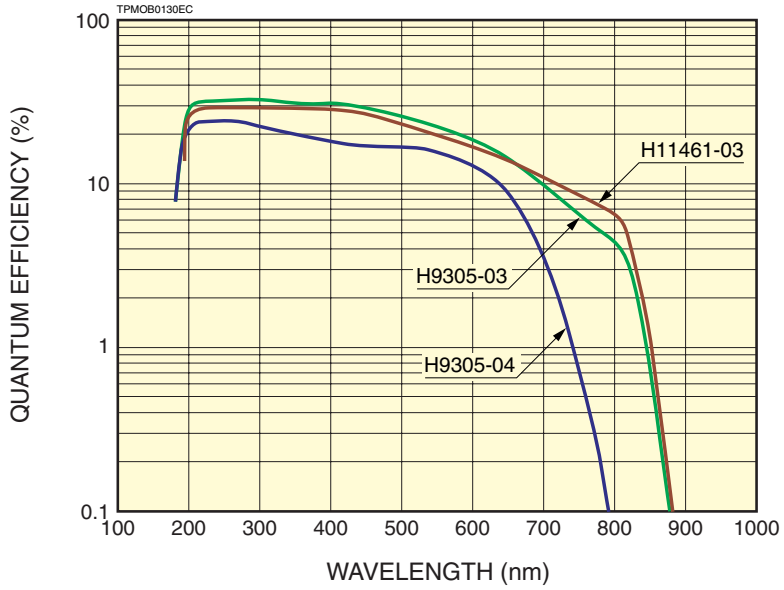


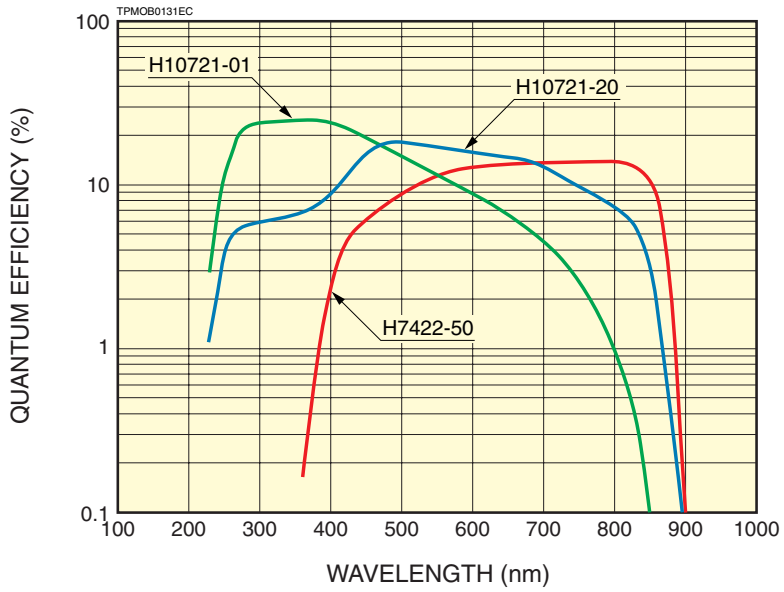
Typical Quantum Efficiency (Unit: %)

Wavelength	H11461-01	H9305-01	H9305-05	H7826	H10721-110	H7422-40
200 nm	17.4	27.3	11.8	—	—	—
300 nm	22.7	28.9	19.5	20.0	32.6	6.0
400 nm	21.5	27.3	13.0	25.7	34.1	28.2
500 nm	14.4	16.4	5.8	16.1	20.5	40.0
600 nm	5.6	5.0	0.9	2.4	5.0	36.1
700 nm	0.2	0.7	—	—	0.3	7.7

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



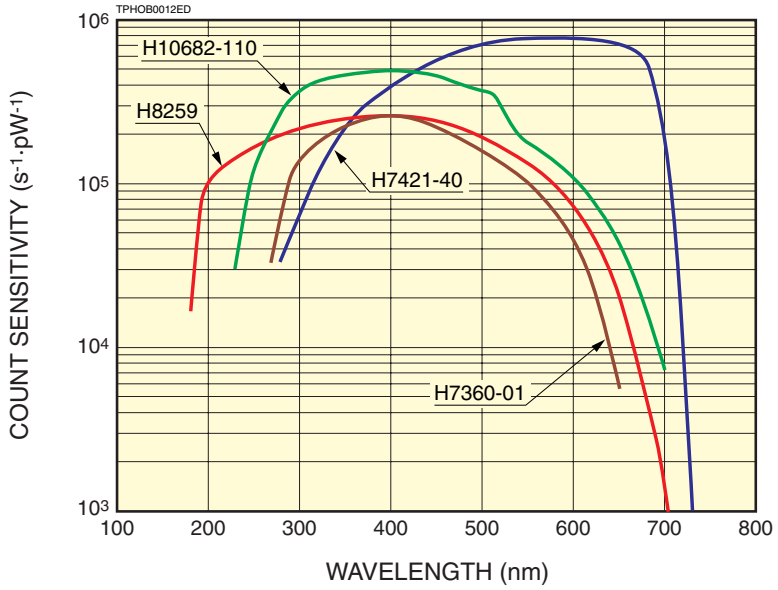


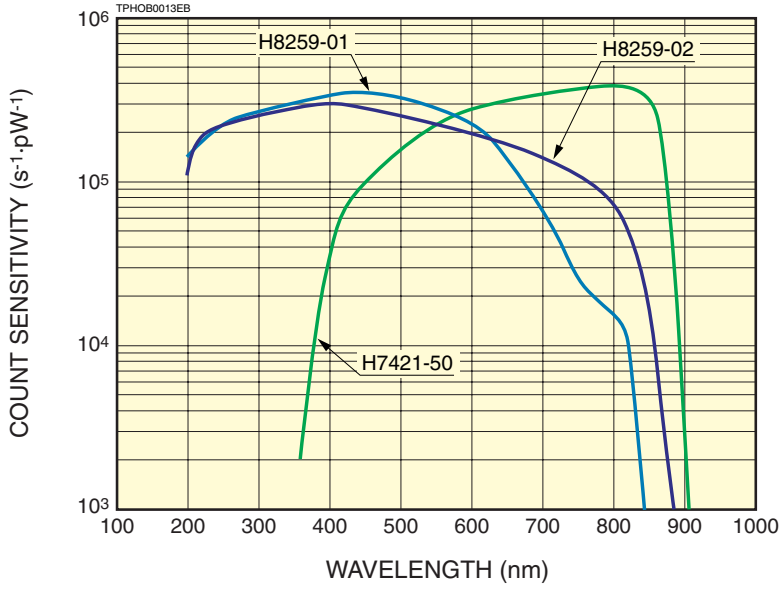
Typical Quantum Efficiency (Unit: %)

Wavelength	H9305-03	H9305-04	H11461-03	H10721-01	H10721-20	H7422-50
200 nm	29.0	21.3	24.8	—	—	—
300 nm	32.9	22.3	28.9	24.0	6.0	—
400 nm	31.3	18.3	27.0	23.8	8.9	2.3
500 nm	25.7	16.6	22.1	15.0	18.3	8.8
600 nm	18.6	12.9	16.3	8.8	15.9	12.9
700 nm	9.7	3.5	10.5	4.6	12.8	13.7
800 nm	4.3	0.1	6.4	1.0	7.4	13.9

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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	H10682-110	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	3.7×10^5	—	6.3×10^4	1.4×10^5	2.1×10^5	2.7×10^5	2.5×10^5
400 nm	4.9×10^5	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	3.7×10^5	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	1.1×10^5	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	7.7×10^3	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

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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 (H10721, 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



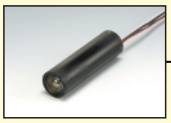
Current/Voltage Output Type → Commercial Oscilloscope



Current Output Type →  Amplifier Unit (P.66) → Commercial Oscilloscope

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Connecting to ammeters

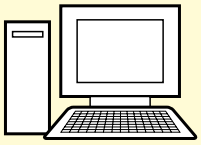


Current Output Type → Commercial Ammeter

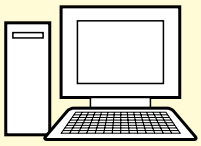
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Using AD converters



Current Output Type →  Data Acquisition Unit (P.67) ↔ RS-232C ↔ 

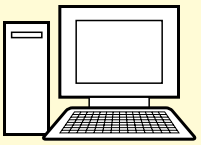


Current Output type →  Amplifier Unit (P.66) → Commercial ADC Board → 

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Time-correlated Single photon Counting

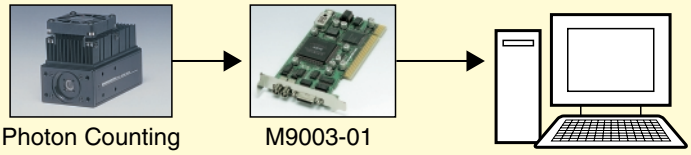


Current Output Type →  Amplifier Unit (P.66) → Commercial CFD → Commercial TAC → 

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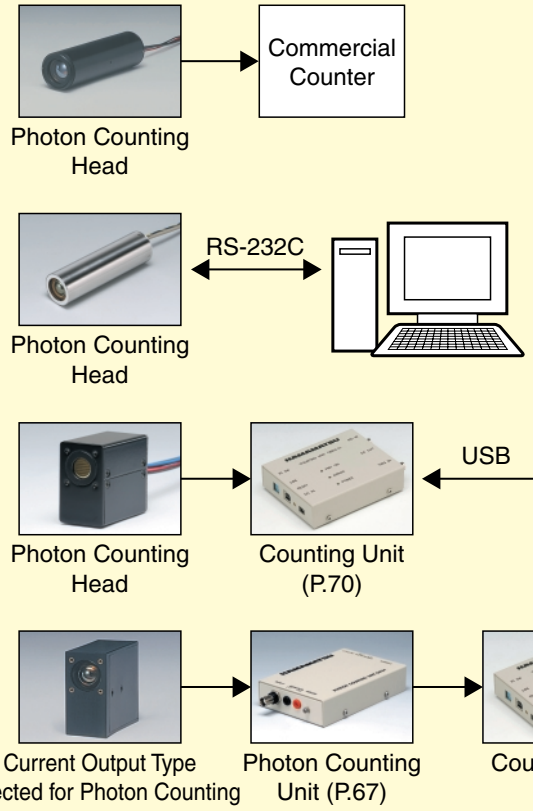
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Fluorescence correlation spectroscopy



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Photon counting



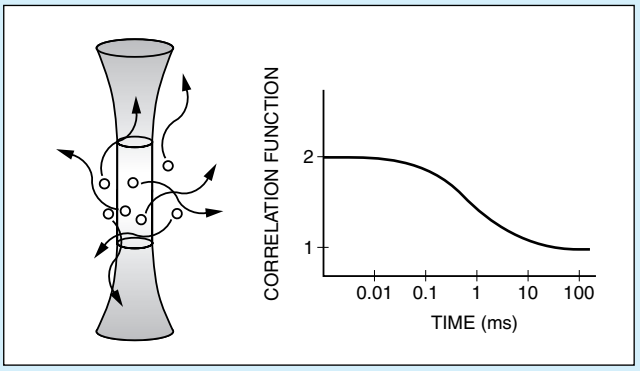
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Application Examples

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.



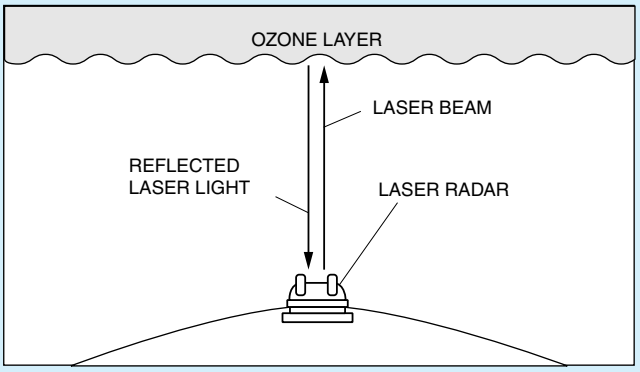
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Vital characteristics
- High quantum efficiency
- Less after pulse

PMT module
- H7421-40 (P. 52)

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.



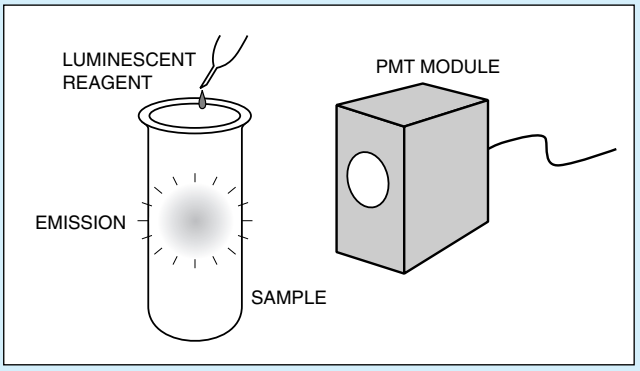
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Vital characteristics
- Gated operation
- Less after pulse

PMT module
- H11526 Series (P. 46)
- H7360-01 (P. 60)

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

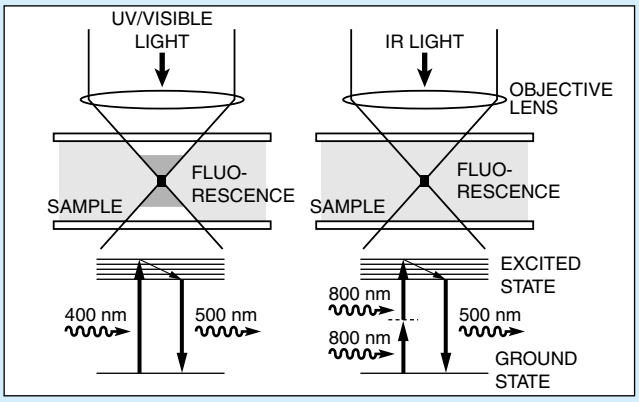
Vital characteristics
- Compact and light weight
- Low power consumption

PMT module
- H7828 (P. 58)

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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.



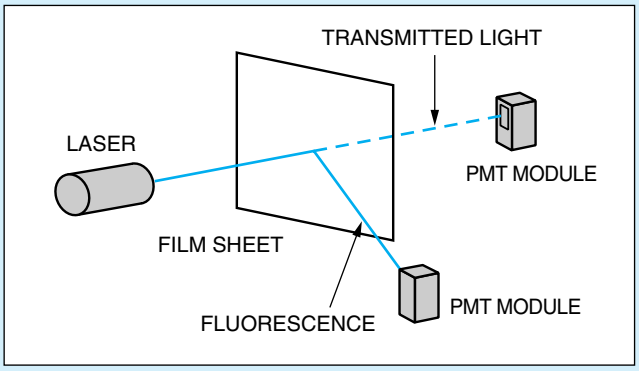
TPMOC0138EA

Vital characteristics
- High quantum efficiency

PMT module
- H7422-40 (P. 18)
- H9305-03 (P. 22)

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.



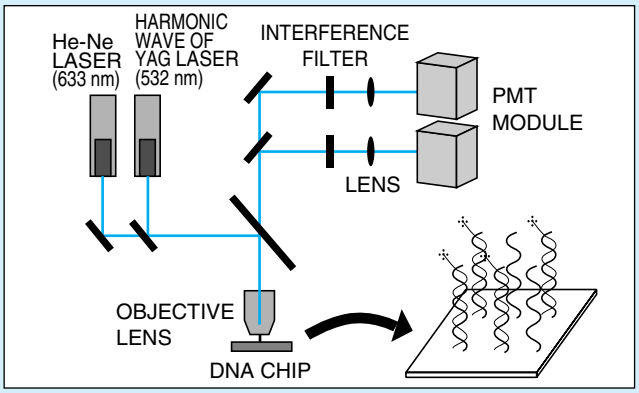
TPMOC0139EA

Vital characteristics
- Wide dynamic range
- High sensitivity

PMT module
- H10721-110 (P. 16)
- H11461-01 (P. 24)

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

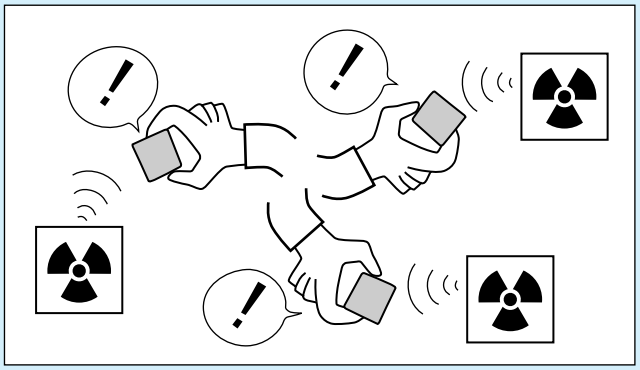
Vital characteristics
- High quantum efficiency
- High-speed response

PMT module
- H9305 Series (P. 22)

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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.



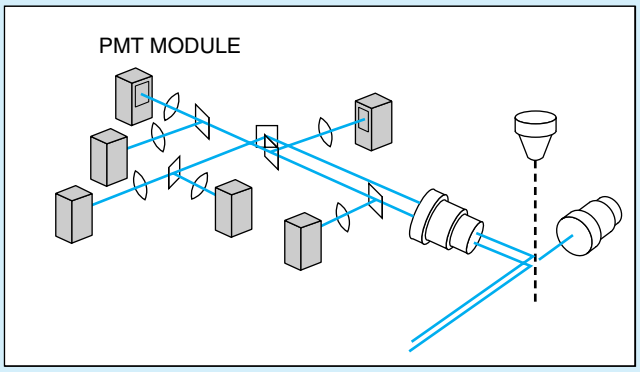
TPMOC0141EA

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

PMT module
- H10720-110 (P. 16)
- H7826 (P. 26)

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.



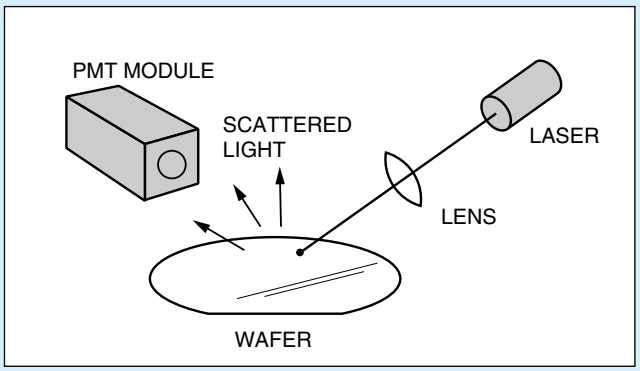
TPMOC0142EB

Vital characteristics
- High-speed response
- High quantum efficiency

PMT module
- H9305 Series (P. 22)
- H10720/H10721 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

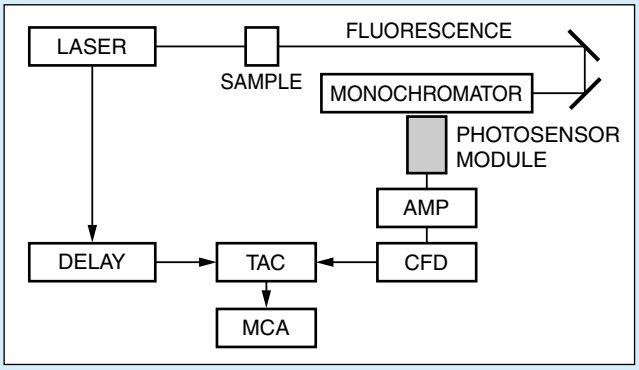
Vital characteristics
- High-speed response
- Wide dynamic range

PMT module
- H10721-01 (P. 16)

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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.



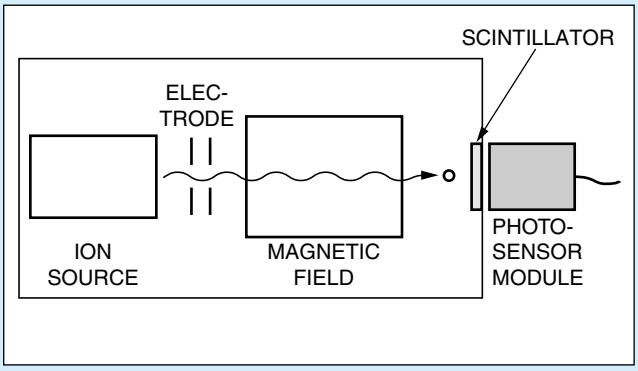
TPMOC0163EA

Vital characteristics
- High-speed response
- High Gain

PMT module
- H10721P-110 (P. 16)
- H7422P Series (P. 18)

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.



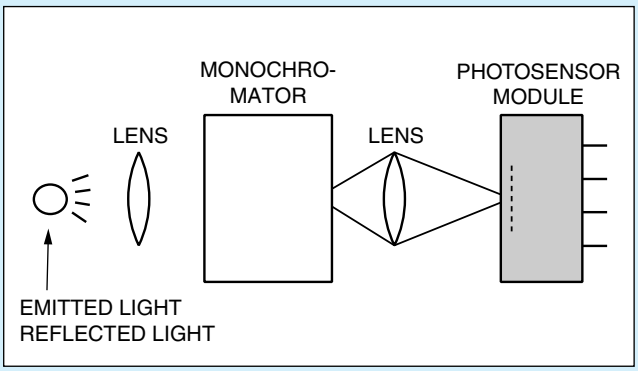
TPMOC0164EA

Vital characteristics
- Wide dynamic range

PMT module
- H10720-110 (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
- H10720 Series (P. 16)

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Metal Package PMT

Photosensor Modules H10720/H10721 Series



The H10720 and H10721 series are photosensor modules containing a metal package PMT and a high-voltage power supply circuit. The built-in PMT uses a metallic package with the same diameter as a TO-8 metal package used for semiconductor photodetectors. Despite the small size nearly equal to photodiodes, this PMT delivers high gain, wide dynamic range, and high-speed response. Four types of photocathodes are available, including a super bialkali photocathode that has higher sensitivity than conventional bialkali photocathodes, an ultra bialkali photocathode that offers even higher sensitivity, a multialkali photocathode with sensitivity extending to the near infrared region, and a red sensitivity enhanced multialkali photocathode. Hamamatsu also provides "P" type with low dark count selected for photon counting measurement.

The H10720 series are lead pin output type, while the H10721 are flexible cable output type.

Product Variations

Type No.	Spectral Response	Output Type	Features
H10720-110 / H10721-110	230 nm to 700 nm	H10720 Series On-board H10721 Series Cable output	Super bialkali photocathode, high sensitivity in visible range
H10720-210 / H10721-210	230 nm to 700 nm		Ultra bialkali photocathode, high sensitivity in visible range
H10720-01 / H10721-01	230 nm to 870 nm		For UV to near IR range
H10720-20 / H10721-20	230 nm to 920 nm		Infrared-extended multialkali photocathode with enhanced sensitivity
H10720P-110 / H10721P-110	230 nm to 700 nm		For photon counting

This product can't be used at vacuum environment or reduced pressure environment.

Specifications

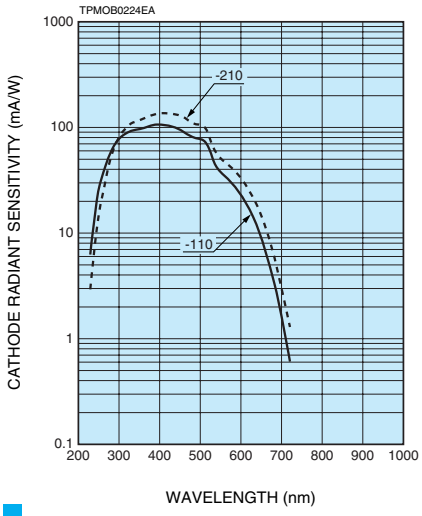
(at +25 °C)

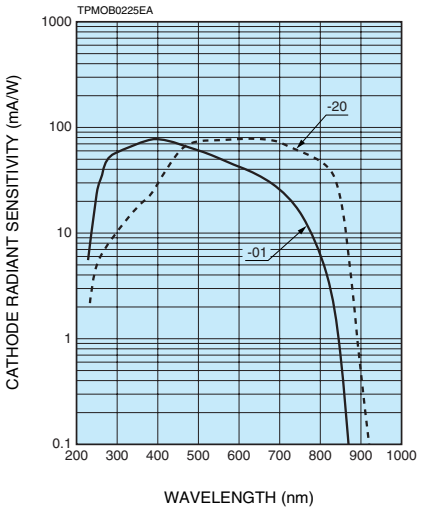
Parameter			H10720 / H10721 Series				Unit
Suffix			-110	-210	-01	-20	—
Input Voltage			+4.5 to +5.5				V
Max. Input Voltage			+5.5				V
Max. Input Current *1			2.7				mA
Max. Output Signal Current *2			100				μA
Max. Control Voltage			+1.1 (Input Impedance 1 MΩ)				V
Recommended Control Voltage Adjustment Range			+0.5 to +1.1 (Input Impedance 1 MΩ)				V
Effective Area			φ8				mm
Peak Sensitivity Wavelength			400	400	400	630	nm
Cathode	Luminous Sensitivity	Min.	80	100	100	350	μA/lm
		Typ.	105	135	200	500	
	Blue Sensitivity Index (CS 5-58)	Typ.	13.5	15.5	—	—	—
	Red / White Ratio	Typ.	—	—	0.2	0.45	—
	Radiant Sensitivity *3	Typ.	110	130	77	78	mA/W
Anode	Standard Type: Luminous Sensitivity *2	Min.	80	100	100	350	A/lm
		Typ.	210	270	400	1000	
	Standard Type: Radiant Sensitivity *2 *3	Typ.	2.2×10^5	2.6×10^5	1.5×10^5	1.5×10^5	A/W
	Standard Type: Dark Current *2 *4	Typ.	1	1	1	10	nA
		Max.	10	10	10	100	
	P Type Dark Count *2 *4	Typ.	50	—	—	—	s^{-1}
		Max.	100	—	—	—	
Rise Time *2			0.57				ns
Ripple Noise *2 *5 (peak to peak)		Max.	0.3				mV
Settling Time *6		Max.	10				s
Operating Ambient Temperature *7			+5 to +50				°C
Storage Temperature *7			-20 to +50				°C
Weight		Typ.	45 (H10720 Series), 80 (H10721 Series)				g

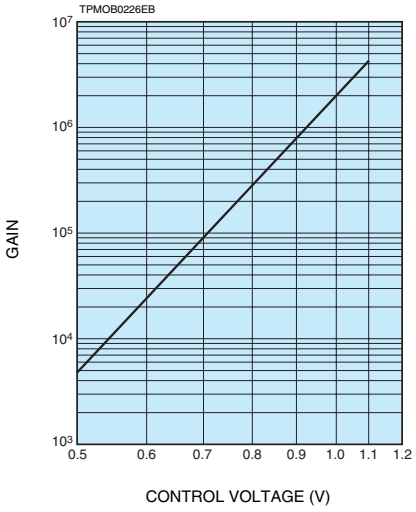
*1: At +5 V input voltage, +1.0 V control voltage, and output current equal to dark current
*2: Control voltage = +1.0 V
*3: Measured at the peak sensitivity wavelength
*4: After 30 minutes storage in darkness.
*5: Cable RG-174/U, Cable length 450 mm, Load resistance = 1 MΩ, Load capacitance = 22 pF
*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

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Characteristics (Cathode radiant sensitivity, Gain)

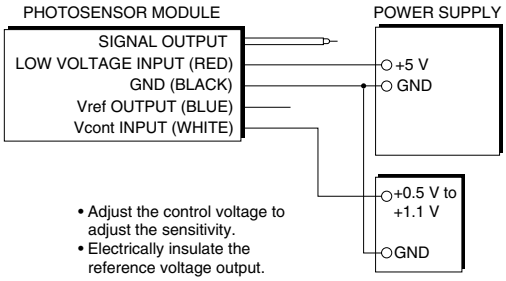






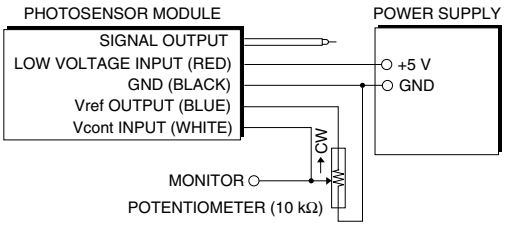
Sensitivity Adjustment Method

VOLTAGE PROGRAMMING



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

RESISTANCE PROGRAMMING

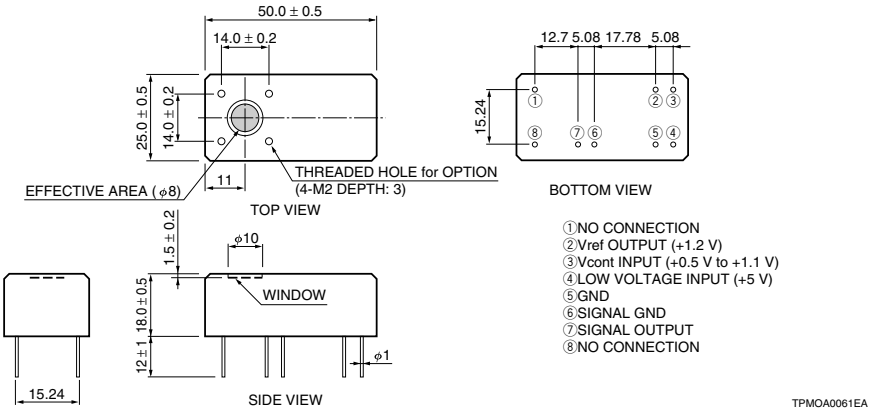


* When using a potentiometer, adjust sensitivity while monitoring the control voltage so it does not exceed +1.1 V.

TPMOC0231EB

Dimensional Outlines (Unit: mm)

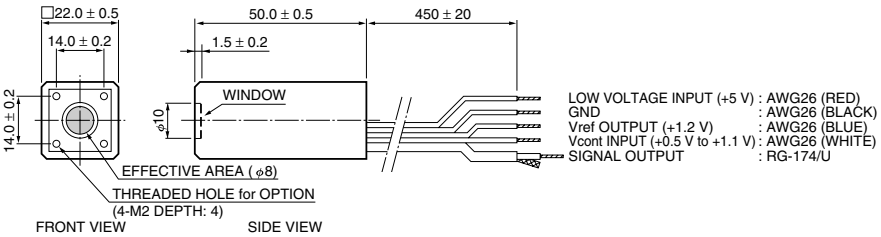
H10720 Series



①NO CONNECTION
②Vref OUTPUT (+1.2 V)
③Vcont INPUT (+0.5 V to +1.1 V)
④LOW VOLTAGE INPUT (+5 V)
⑤GND
⑥SIGNAL GND
⑦SIGNAL OUTPUT
⑧NO CONNECTION

TPMOA0061EA

H10721 Series

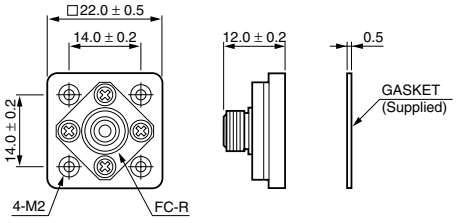


LOW VOLTAGE INPUT (+5 V) : AWG26 (RED)
GND : AWG26 (BLACK)
Vref OUTPUT (+1.2 V) : AWG26 (BLUE)
Vcont INPUT (+0.5 V to +1.1 V) : AWG26 (WHITE)
SIGNAL OUTPUT : RG-174/U

TPMOA0062EA

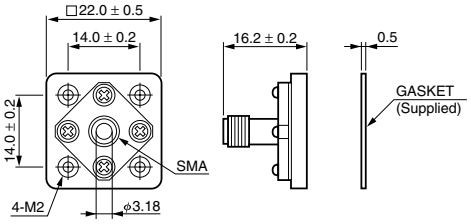
Options (Optical Fiber Adapter) (Unit: mm)

E5776 (FC Type)



TACCA0055EB

E5776-51 (SMA Type)



TACCA0239EB

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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 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

This product can't be used at vacuum environment or reduced pressure environment.

Specifications

(at +25 °C)

Parameter					H7422-40	H7422-50	Unit
Input Voltage					+11.5 to +15.5		V
Max. Input Voltage for Main Unit					+18		V
Max. Input Current for Main Unit					62		mA
Max. Input Voltage for Thermoelectric Cooler					2.6		V
Max. Input Current for Thermoelectric Cooler					2.2		A
Max. Output Signal Current					2		μA
Max. Control Voltage					+0.9 (Input impedance 100 kΩ)		V
Recommended Control Voltage Adjustment Range					+0.5 to +0.8		V
Effective Area					φ5		mm
Sensitivity Adjustment Range					1: 50		—
Peak Sensitivity Wavelength					580	800	nm
Cathode	Radiant Sensitivity		Typ.	420 nm	108	15	mA/W
				550 nm	176	50	
				800 nm	—	90	
Anode	Standard Type	Radiant Sensitivity *1	Typ.	550 nm	8.8×10^4	2.5×10^4	A/W
		Dark Current *1 *2	Typ.		0.4	0.5	nA
			Max.		1.0	1.3	
	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		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 A7423
*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

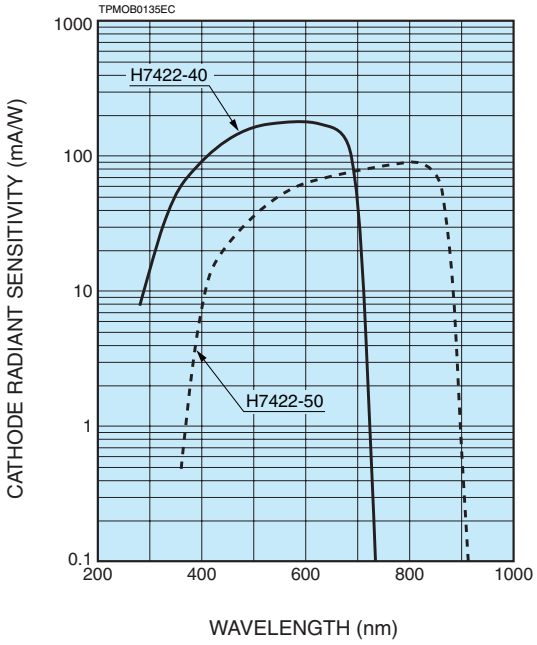
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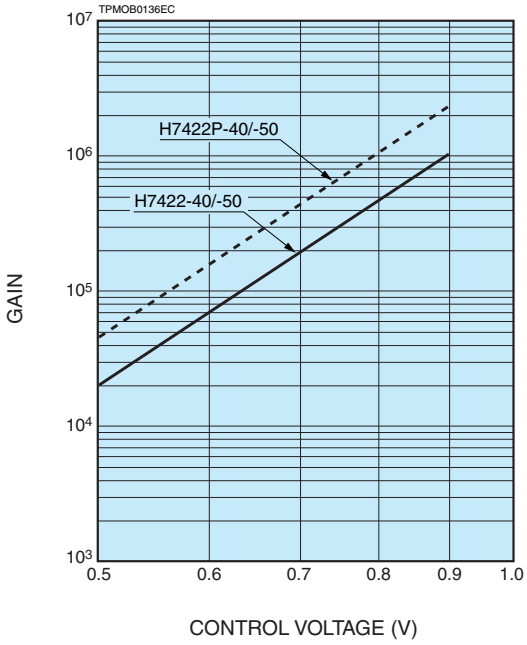
Cooling Specifications

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

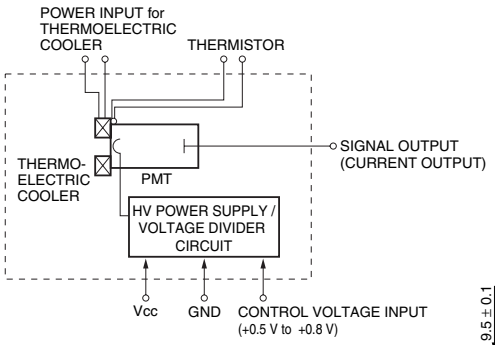
*7: Input current to thermoelectric cooler=2 A

Characteristics (Cathode radiant sensitivity, Gain)



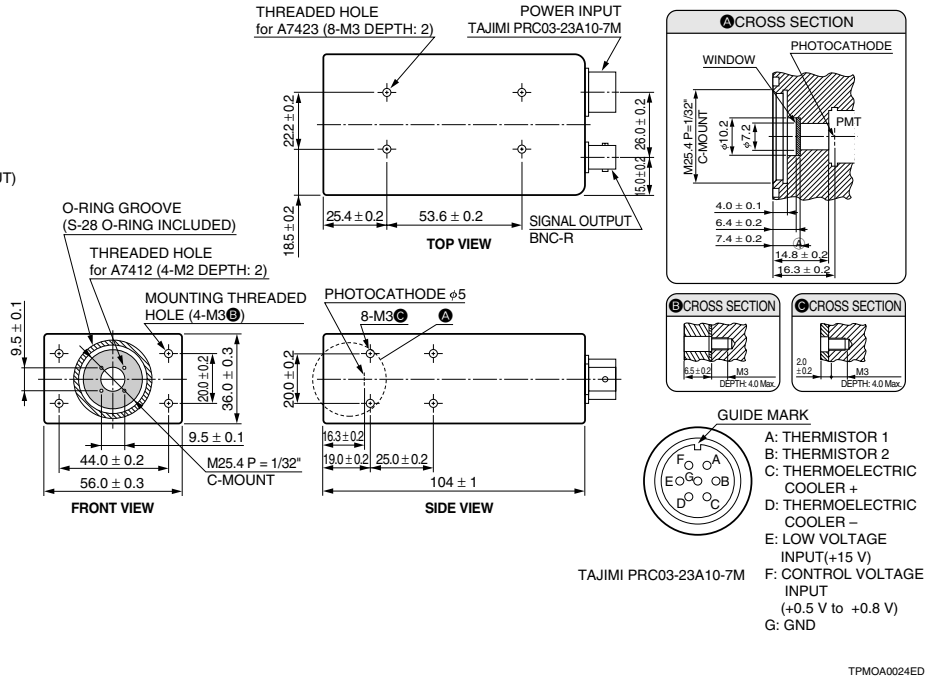


Block Diagram



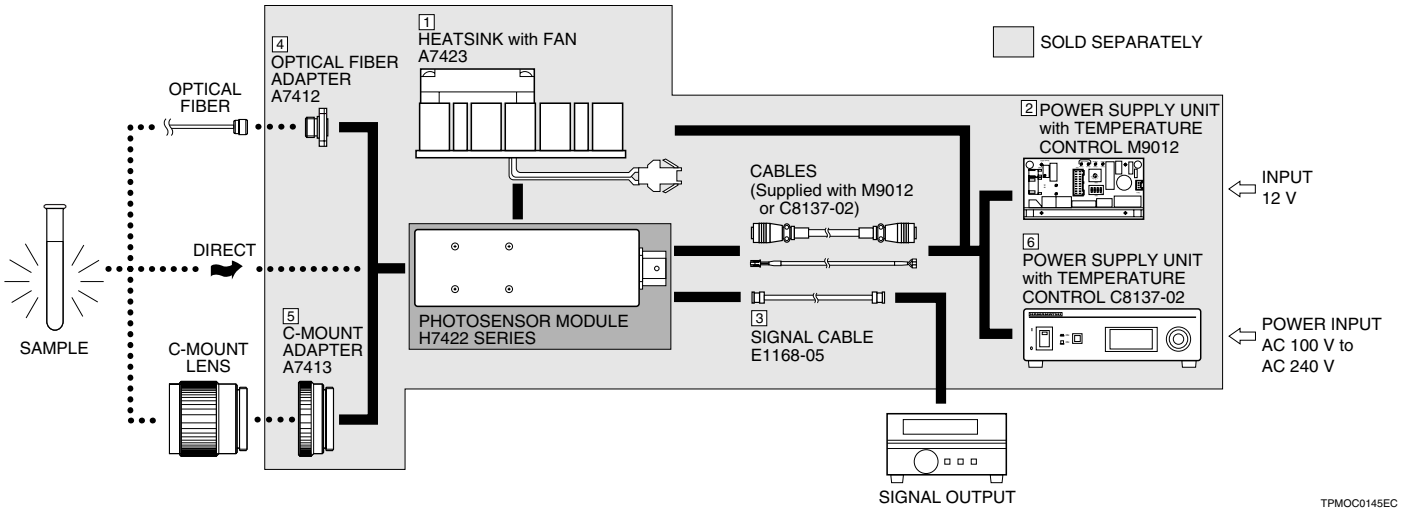
In order to protect the PMT module from being damaged by excessive light, the H7422-40/50 has a protective function circuit. The circuit automatically turns off high voltage if the output current exceeds the preset current limit (approx. 10 μA). This protection circuit works whenever the preset current 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)



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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

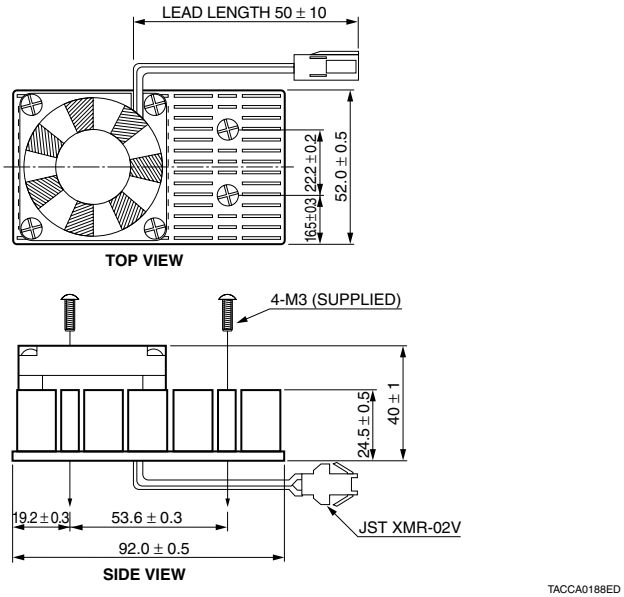
The C8137-02 is a power supply unit with a temperature control function. Just connecting to an AC source of 100 V to 240 V generates the output voltages for the thermoelectric cooler and the A7423 fan, needed for operating the H7422. The photomultiplier tube temperature can be maintained to 0 °C by monitoring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

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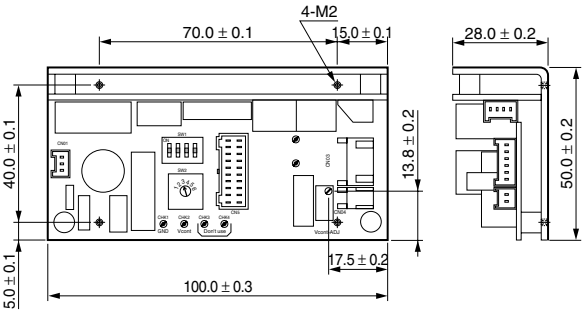
Options (Unit: mm)

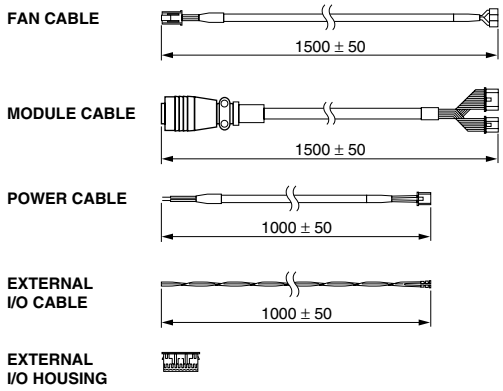
1 Heatsink with Fan A7423



TACCA0188ED

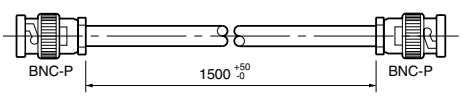
2 Power Supply Unit with Temperature Control M9012





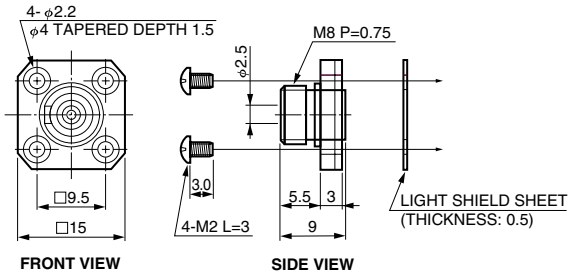
TACCA0251EA

3 Signal Cable E1168-05



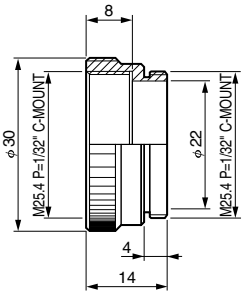
TACCA0148EA

4 Optical Fiber Adapter (FC Type) A7412



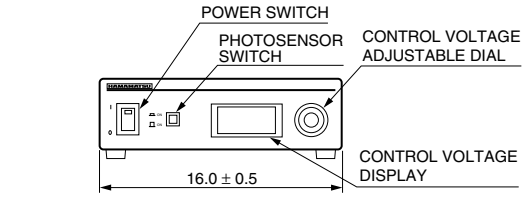
TACCA0190EB

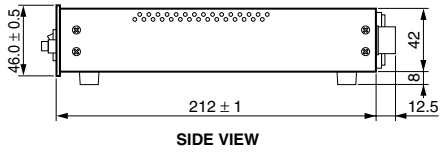
5 C-mount Adapter A7413

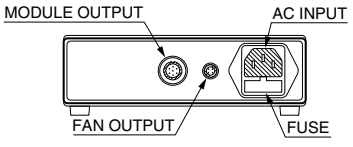


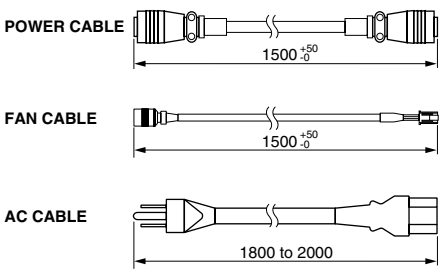
TACCA0191EA

6 Power Supply Unit with Temperature Control C8137-02









TACCA0238EB

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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. 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

This product can't be used at vacuum environment or reduced pressure environment. Please pay attention when the H9305 series is used for measuring the light below 190 nm.

Specifications

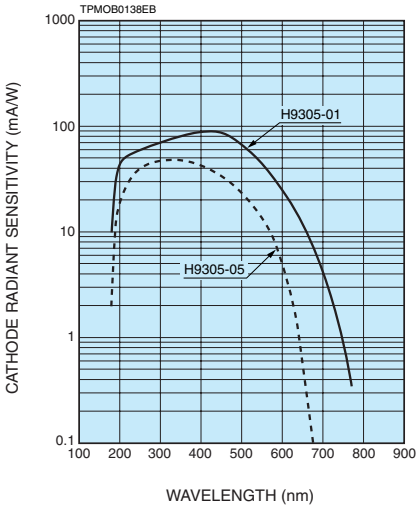
(at +25 °C)

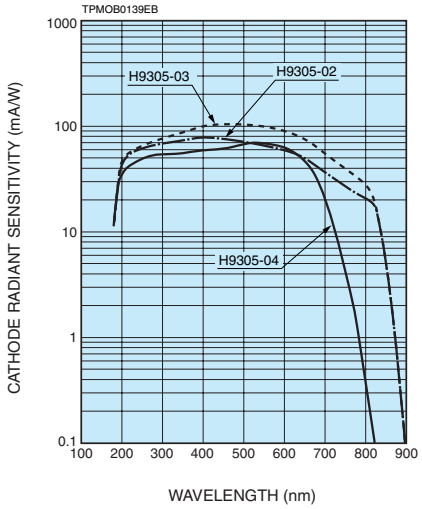
Parameter			H9305 Series					Unit
Suffix			-01	-02	-03	-04	-05	—
Input Voltage			+11.5 to +15.5					V
Max. Input Voltage			+18					V
Max. Input Current			7					mA
Max. Output Signal Current			10					μA
Max. Control Voltage			+1.2 (Input impedance: 1 MΩ)					V
Recommended Control Voltage Adjustment Range			+0.25 to +1.0					V
Effective Area			3.7 × 13.0					mm
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	1200	2000	700	300	
	Radiant Sensitivity *1 *2	Typ.	5.2×10^5	3.1×10^5	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

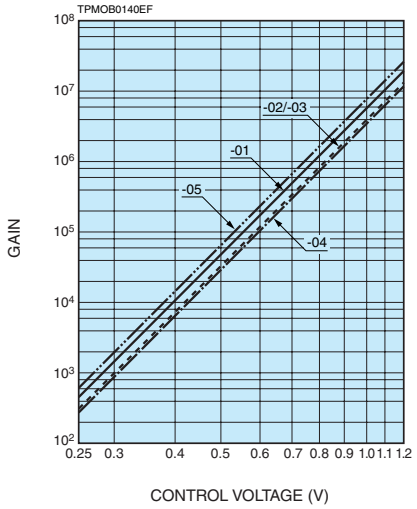
*1: Measured at the peak sensitivity wavelength
*2: Control voltage = +1.0 V
*3: After 30 minutes storage in darkness
*4: Cable RG-174/U, Cable length 450 mm, Load resistance = 1 MΩ, Load capacitance = 22 pF
*5: The time required for the output to reach a stable level following a change in the control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

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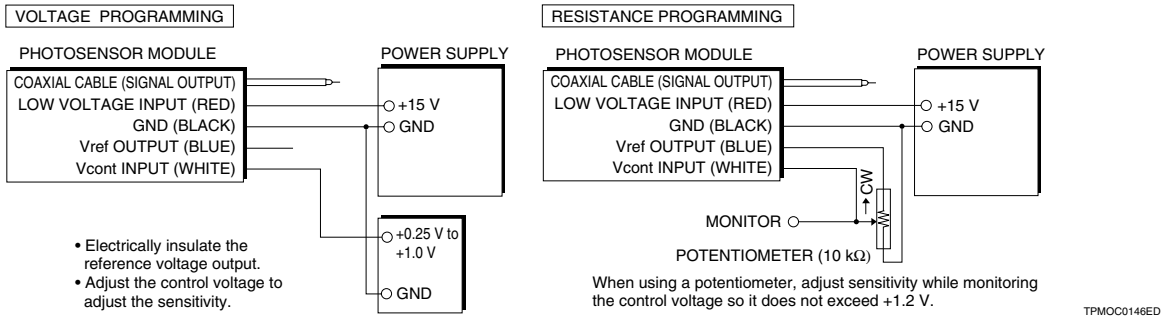
Characteristics (Cathode radiant sensitivity, PMT gain)



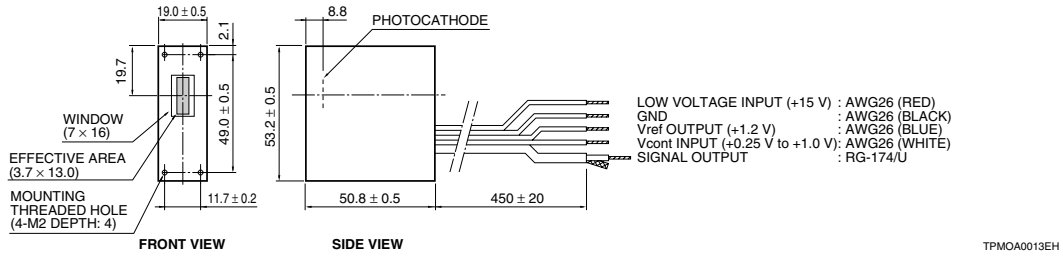




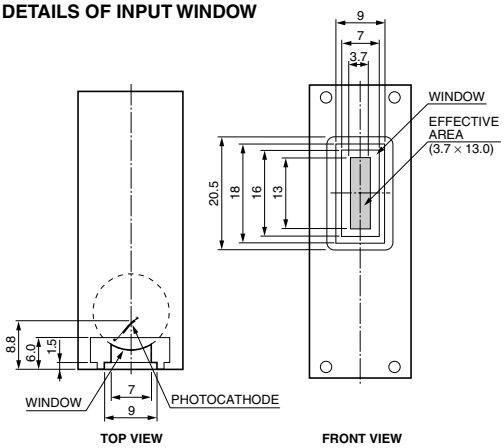
Sensitivity Adjustment Method



Dimensional Outlines (Unit: mm)



DETAILS OF INPUT WINDOW



Side-on PMT

Photosensor Modules H11461 Series



The H11461 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. Six types of photomultiplier tubes are provided as standard lineups to meet various needs for spectral response range.

The H11461P-01 and H11461P-11 are selected as low dark count types ideal for photon counting and low-light-level measurement.

Product Variations

Type No.	Spectral Response	Features
H11461-01	185 nm to 710 nm	Low noise in UV to visible range
H11461-02	185 nm to 900 nm	For UV to near IR range
H11461-03	185 nm to 900 nm	High sensitivity in UV to near IR range
H11461P-01	185 nm to 710 nm	For photon counting in UV to visible range
H11461P-11	185 nm to 850 nm	For photon counting in UV to near IR range
H11461-09	160 nm to 320 nm*	For UV range, Cs-Te photocathode

This product can't be used at vacuum environment or reduced pressure environment. Please pay attention when the H11461 series is used for measuring the light below 190 nm.

Specifications

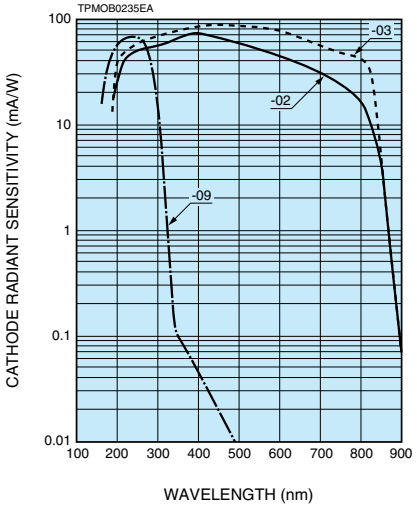
(at +25 °C)

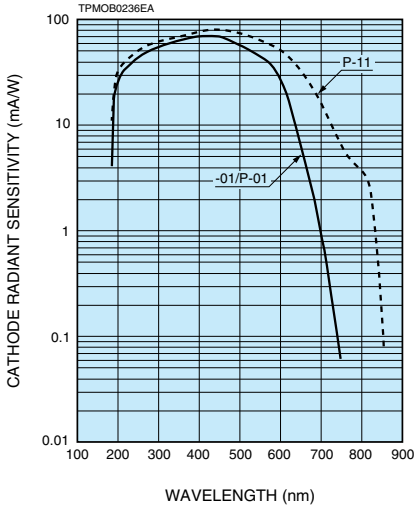
Parameter			H11461 Series						Unit
Suffix			-01	-02	-03	P-01	P-11	-09	—
Input Voltage			+4.5 to +5.5						V
Max. Input Voltage			+6.0						V
Max. Input Current *1			3.5						mA
Max. Output Signal Current *2			100						μA
Max. Control Voltage			+1.2 (Input impedance 1 MΩ)						V
Recommended Control Voltage Adjustment Range			+0.5 to +1.1 (Input impedance 1 MΩ)						V
Effective Area			4 × 20						mm
Peak Sensitivity Wavelength			410	400	450	410	430	230	nm
Cathode	Luminous Sensitivity	Min.	80	140	475	80	140	—	μA/lm
		Typ.	100	250	525	100	200	—	
	Blue Sensitivity Index (CS 5-58)	Typ.	8	—	—	8	—	—	—
	Red/White Ratio	Typ.	—	0.3	0.4	—	0.15	—	—
	Radiant Sensitivity *3	Typ.	70	74	90	70	80	62	mA/W
Anode	Luminous Sensitivity *2	Min.	1000	400	3000	1000	300	—	A/lm
		Typ.	1200	2500	5000	1200	700	—	
	Radiant Sensitivity *2 *3	Typ.	8.4×10^5	7.4×10^5	8.6×10^5	8.4×10^5	2.8×10^5	6.2×10^5	A/W
	Dark Current *2 *4	Typ.	0.2	3	10	0.1	0.2	1	nA
		Max.	2	50	50	0.5	1	10	
	Dark Count *4 *5	Typ.	—	—	—	30	80	—	s^{-1}
		Max.	—	—	—	80	200	—	
Rise Time *2			2.2						ns
Ripple Noise *2 *6 (peak to peak)		Max.	0.3						mV
Settling Time *7		Max.	10						s
Operating Ambient Temperature *8			+5 to +50						°C
Storage Temperature *8			-20 to +50						°C
Weight			225						g

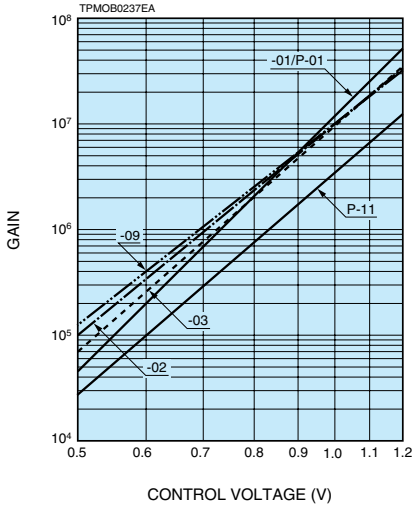
*1: At +5 V input voltage, +1.0 V control voltage, and output current equal to dark current. *2: Control voltage = +1.0 V
*3: Measured at the peak sensitivity wavelength (-09: 254 nm) *4: After 30 minutes storage in darkness *5: Control voltage: Plateau voltage
*6: Cable RG-174/U, Cable length 450 mm, 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. *8: No condensation

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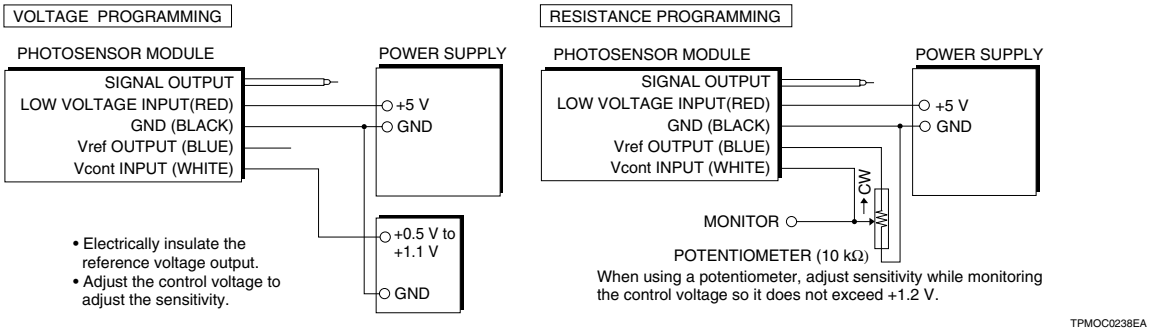
Characteristics (Cathode radiant sensitivity, Gain)



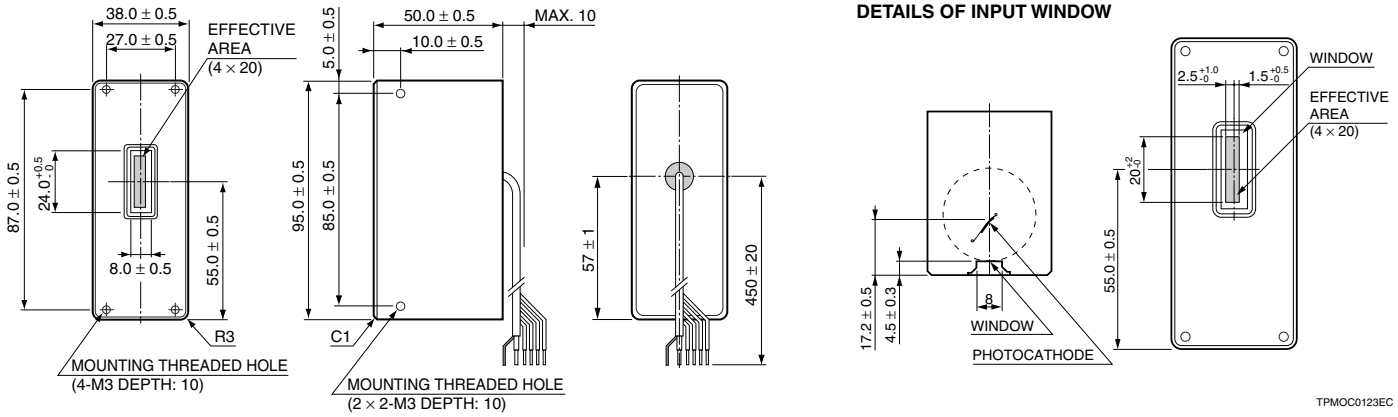




Sensitivity Adjustment Method



Dimensional Outlines (Unit: mm)



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

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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 series 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

This product can't be used at vacuum environment or reduced pressure environment.

Specifications

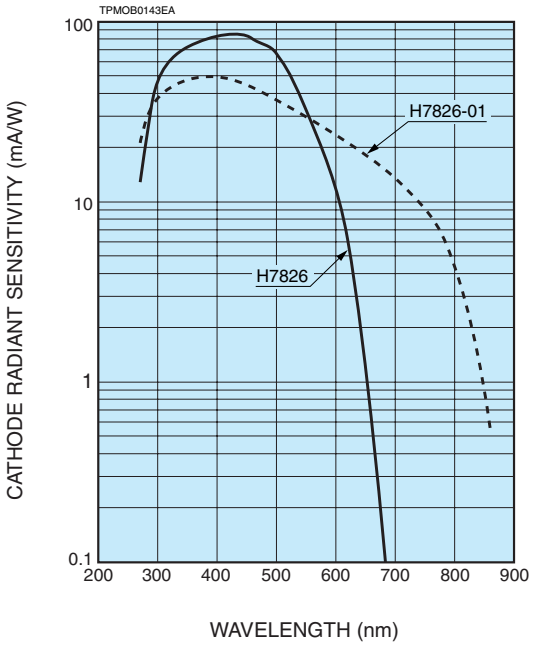
(at +25 °C)

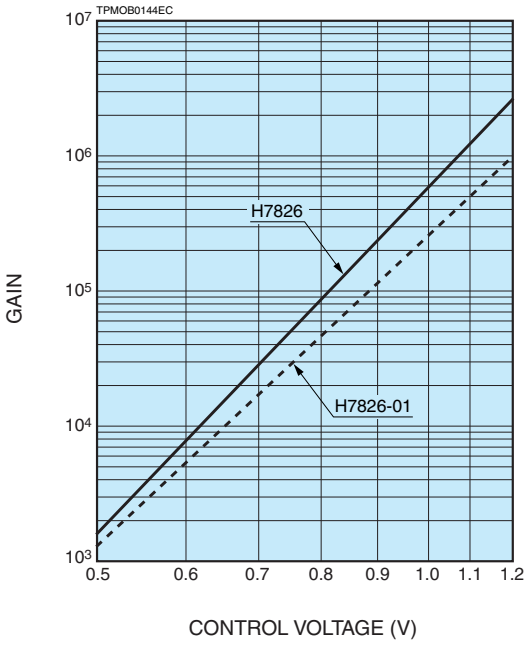
Parameter			H7826	H7826-01	H7826P	H7826P-01	Unit
Input Voltage			+11.5 to +15.5				V
Max. Input Voltage			+18				V
Max. Input Current			40				mA
Max. Output Signal Current			100				μA
Max. Control Voltage			+1.2 (Input impedance 100 kΩ)				V
Recommended Control Voltage Adjustment Range			+0.5 to +1.1				V
Effective Area			φ15				mm
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

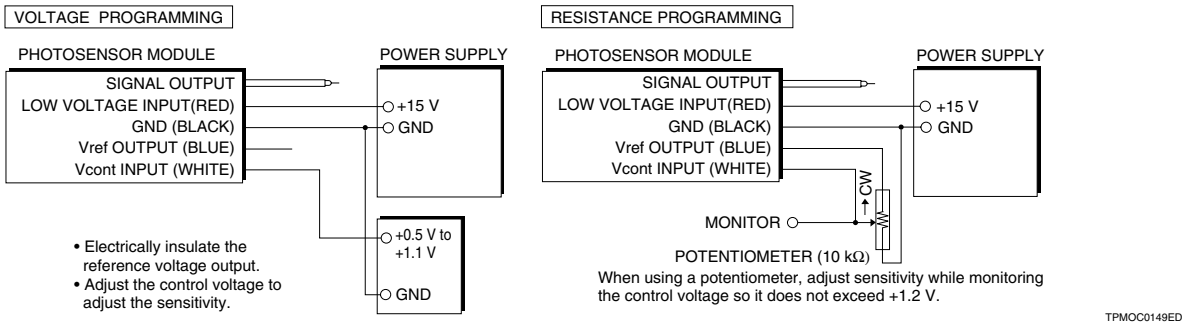
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Characteristics (Cathode radiant sensitivity, Gain)

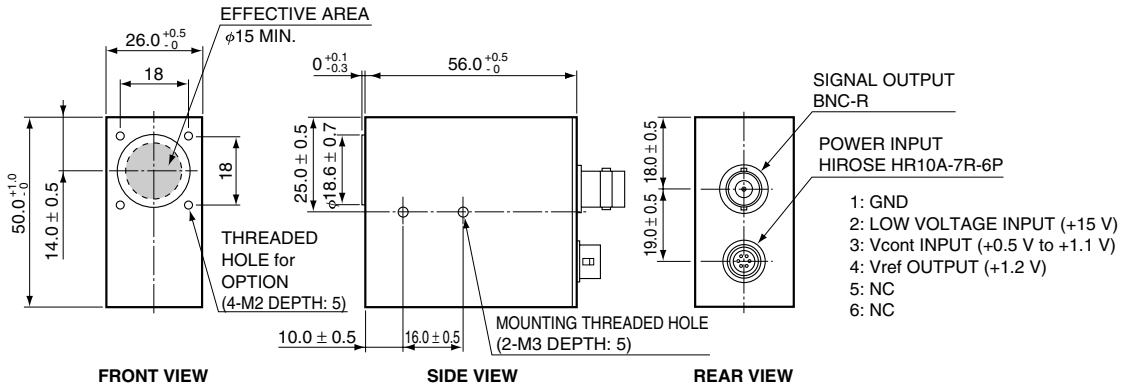




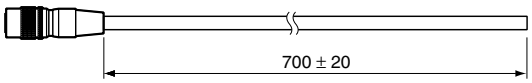
Sensitivity Adjustment Method



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

TPMOA0005EE

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Head-on PMT

Photosensor Modules H10425 Series



The H10425 series is a photosensor module containing a 25-mm (1") diameter head-on photomultiplier tube and a high-voltage power supply. It has a photosensitive area as large as 22 mm in diameter and also features a fast time response.

Two products, one with a bialkali photocathode and one with a multialkali photocathode, are provided.

Product Variations

Type No.	Spectral Response	Features
H10425	300 nm to 650 nm	For visible range
H10425-01	300 nm to 850 nm	For visible to near IR range

This product can't be used at vacuum environment or reduced pressure environment.

Specifications

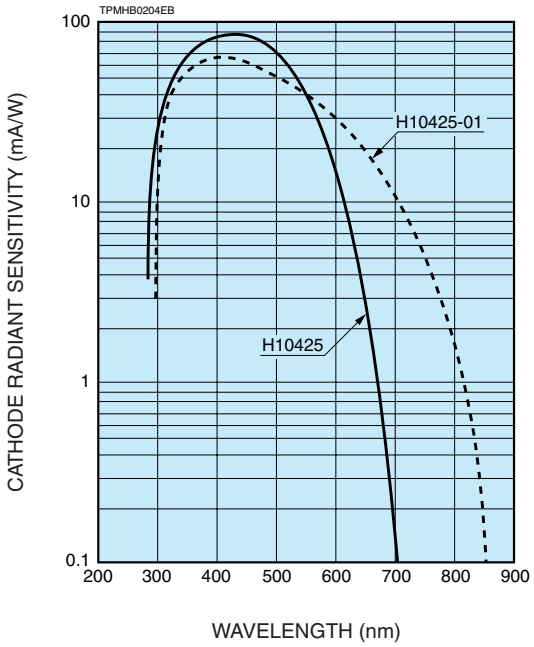
(at +25 °C)

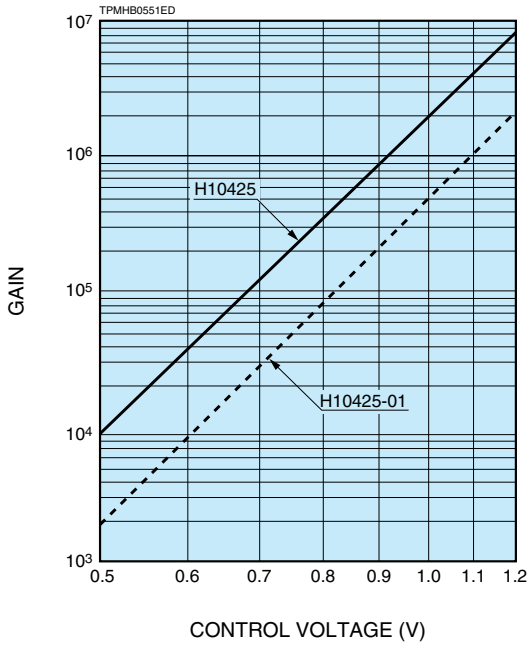
Parameter			H10425	H10425-01	Unit
Input Voltage			+11.5 to +15.5		V
Max. Input Voltage			+18		V
Max. Input Current *1			3.0		mA
Max. Output Signal Current			100		μA
Max. Control Voltage			+1.2 (Input impedance 1 MΩ)		V
Recommended Control Voltage Adjustment Range *2			+0.5 to +1.1		V
Effective Area			φ22		mm
Peak Sensitivity Wavelength			420		nm
Cathode	Luminous Sensitivity	Min.	60	80	μA/lm
		Typ.	90	150	
	Blue Sensitivity Index (CS 5-58)	Typ.	10.5	—	—
	Red / White Ratio	Typ.	—	0.2	—
	Radiant Sensitivity *3	Typ.	85	64	mA/W
Anode	Luminous Sensitivity *4	Min.	40	20	A/lm
		Typ.	180	75	
	Radiant Sensitivity *3 *4	Typ.	1.7×10^5	3.2×10^4	A/W
	Dark Current *1 *5	Typ.	3		nA
		Max.	20		
Rise Time *4			1.5		ns
Ripple Noise *4 *6 (peak to peak)			0.5		mV
Settling Time *7		Max.	10		s
Operating Ambient Temperature *8			+5 to +50		°C
Storage Temperature *8			-20 to +50		°C
Weight			170	180	g

*1: At +15 V input voltage, +1.0 V control voltage, and output current equal to dark current.
*2: DAC (I^2C interface) can be installed in the module. Please specify when ordering.
*3: Measured at the peak sensitivity wavelength *4: Control voltage = +1.0 V *5: After 30 minutes storage in darkness
*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.
*8: No condensation

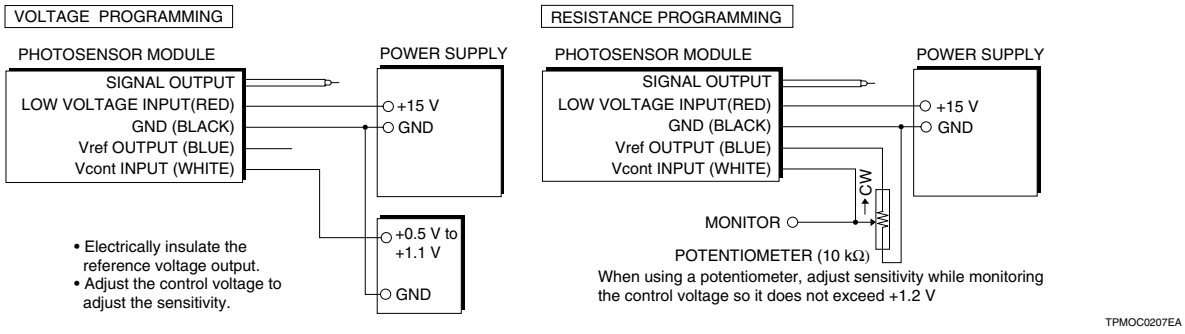
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Characteristics (Cathode radiant sensitivity, Gain)

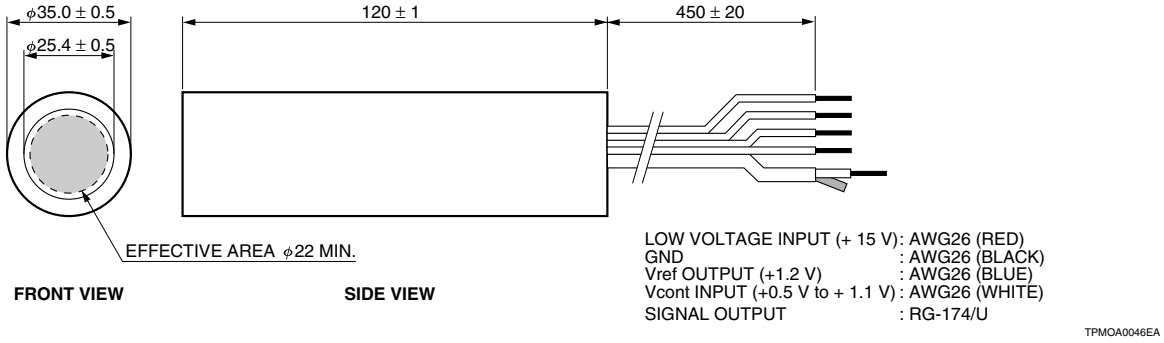




Sensitivity Adjustment Method



Dimensional Outlines (Unit: mm)



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Head-on PMT

Photosensor Modules H10426 Series



The H10426 series is a photosensor module containing a 28-mm (1-1/8") diameter head-on photomultiplier tube and a high-voltage power supply. It has a photosensitive area as large as 25 mm in diameter.
Two products, one with a bialkali photocathode and one with a multialkali photocathode, are provided.

Product Variations

Type No.	Spectral Response	Features
H10426	300 nm to 650 nm	For visible range
H10426-01	185 nm to 850 nm	For UV to near IR range

This product can't be used at vacuum environment or reduced pressure environment. Please pay attention when the H10426-01 is used for measuring the light below 190 nm.

Specifications

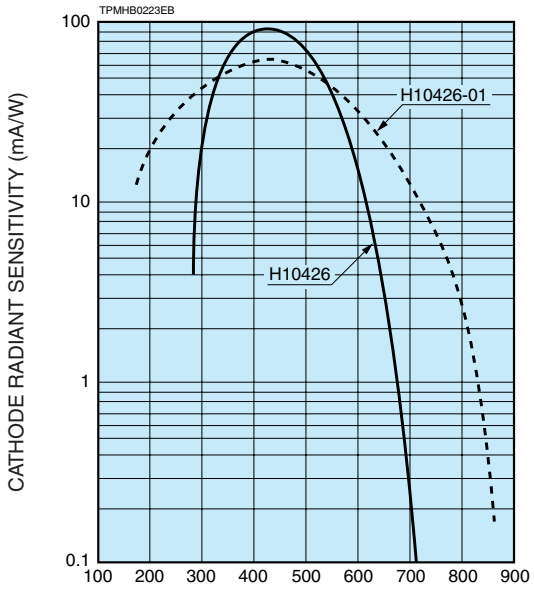
(at +25 °C)

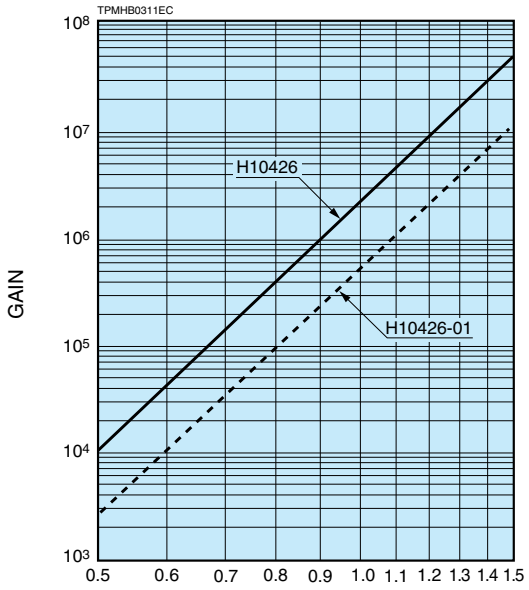
Parameter			H10426	H10426-01	Unit
Input Voltage			+11.5 to +15.5		V
Max. Input Voltage			+18		V
Max. Input Current *1			3.0		mA
Max. Output Signal Current			100		μA
Max. Control Voltage			+1.5 (Input impedance 1 MΩ)		V
Recommended Control Voltage Adjustment Range *2			+0.5 to +1.4		V
Effective Area			φ25		mm
Peak Sensitivity Wavelength			420		nm
Cathode	Luminous Sensitivity	Min.	60	80	μA/lm
		Typ.	95	150	
	Blue Sensitivity Index (CS 5-58)	Typ.	11	—	—
	Red / White Ratio	Typ.	—	0.2	—
	Radiant Sensitivity *3	Typ.	88	64	mA/W
Anode	Luminous Sensitivity *4	Min.	50	20	A/lm
		Typ.	200	80	
	Radiant Sensitivity *3 *4	Typ.	1.8×10^5	3.4×10^4	A/W
	Dark Current *1 *5	Typ.	2	3	nA
		Max.	10	15	
Rise Time *4			4	15	ns
Ripple Noise *4 *6 (peak to peak)			0.5		mV
Settling Time *7		Max.	10		s
Operating Ambient Temperature *8			+5 to +50		°C
Storage Temperature *8			-20 to +50		°C
Weight			270		g

*1: At +15 V input voltage, +1.0 V control voltage, and output current equal to dark current.
*2: DAC (I^2C interface) can be installed in the module. Please specify when ordering.
*3: Measured at the peak sensitivity wavelength *4: Control voltage = +1.0 V *5: After 30 minutes storage in darkness
*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.
*8: No condensation

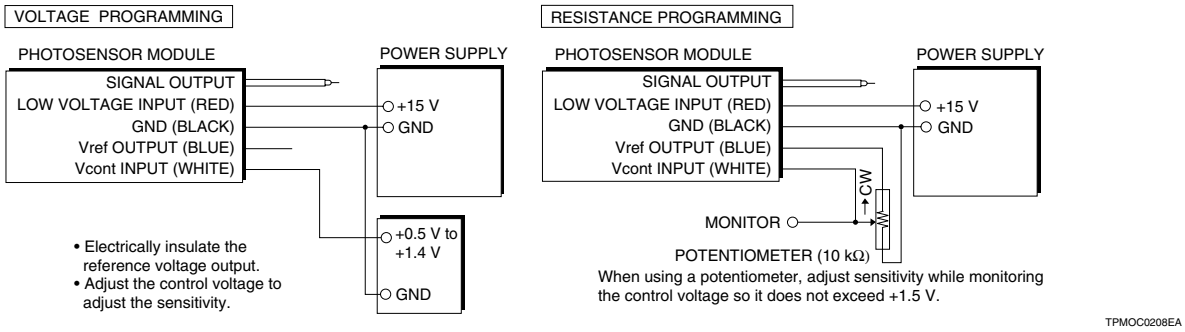
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Characteristics (Cathode radiant sensitivity, Gain)

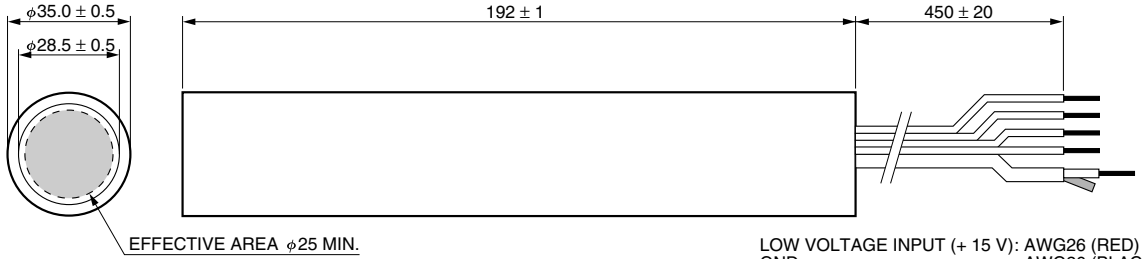




Sensitivity Adjustment Method



Dimensional Outlines (Unit: mm)



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

TPMOA0047EA

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Metal package PMT

Photosensor Modules H10722 Series



The H10722 series is a photosensor module containing a metal package PMT, a low-power consumption high-voltage power supply circuit, and a low-noise amplifier. The amplifier converts the PMT current output to a voltage output so that the signal can be easily processed. Also, the amplifier is connected close to the PMT anode output pin in order to make the signal less affected by external noise. Four types of photocathodes are available, including a super bialkali photocathode that has higher sensitivity than conventional bialkali photocathodes, an ultra bialkali photocathode that offers even higher sensitivity, a multialkali photocathode with sensitivity extending to the near infrared region, and a red sensitivity enhanced multialkali photocathode.

Product Variations

Parameter	Spectral Response	Current-to-Voltage Conversion Factor*	Frequency Bandwidth*	Features
H10722-110	230 nm to 700 nm	1 V/μA	DC to 20 kHz	Super bialkali photocathode, high sensitivity in visible range
H10722-210	230 nm to 700 nm			Ultra bialkali photocathode, high sensitivity in visible range
H10722-01	230 nm to 870 nm			For UV to near IR range
H10722-20	230 nm to 920 nm			Infrared-extended multialkali photocathode with enhanced sensitivity

* The amplifier specification can be changed upon request. Feel free to contact our sales office.
This product can't be used at vacuum environment or reduced pressure environment.

Specifications

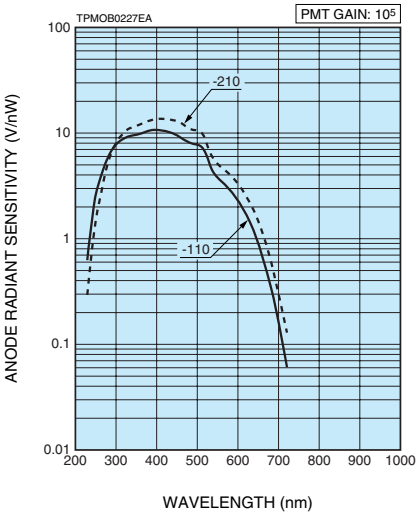
(at +25 °C)

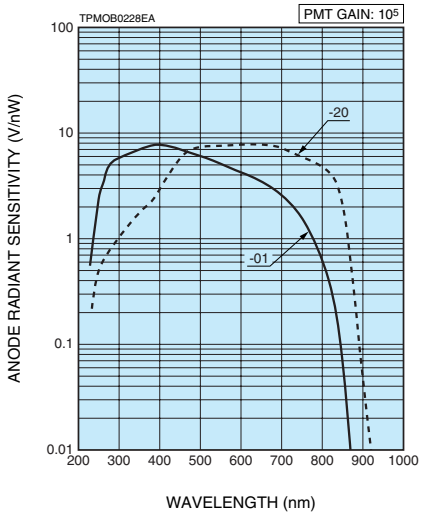
Parameter			H10722-110	H10722-210	H10722-01	H10722-20	Unit
Input Voltage			±4.5 to ±5.5				V
Max. Input Voltage			±5.5				V
Max. Input Current *1			+6.2 / -3.5				mA
Max. Output Signal Voltage *2			+4 (Load resistance 10 kΩ)				V
Max. Control Voltage			+1.1 (Input Impedance 1 MΩ)				V
Recommended Control Voltage Adjustment Range			+0.5 to +1.1 (Input Impedance 1 MΩ)				V
Effective Area			φ8				mm
Peak Sensitivity Wavelength			400	400	400	630	nm
Cathode	Luminous Sensitivity	Min.	80	100	100	350	μA/lm
		Typ.	105	135	200	500	
	Blue Sensitivity Index (CS 5-58)	Typ.	13.5	15.5	—	—	—
	Red / White Ratio	Typ.	—	—	0.2	0.45	—
	Radiant Sensitivity *3	Typ.	110	130	77	78	mA/W
Anode	Luminous Sensitivity *4	Min.	8.0×10^7	1.0×10^8	1.0×10^8	3.5×10^8	V/lm
		Typ.	2.1×10^8	2.7×10^8	4.0×10^8	1.0×10^9	
	Radiant Sensitivity *3 *4	Typ.	220	260	150	150	V/nW
	Voltage Output Depending on PMT Dark Current *4 *5	Typ.	1	1	1	10	mV
		Max.	10	10	10	100	
Current-to-Voltage Conversion Factor			1				V/μA
Output Offset Voltage		Typ.	±1				mV
Ripple Noise *4 *6 (peak to peak)		Max.	0.5				mV
Settling Time *7		Max.	10				s
Operating Ambient Temperature *8			+5 to +50				°C
Storage Temperature *8			-20 to +50				°C
Weight		Typ.	100				g

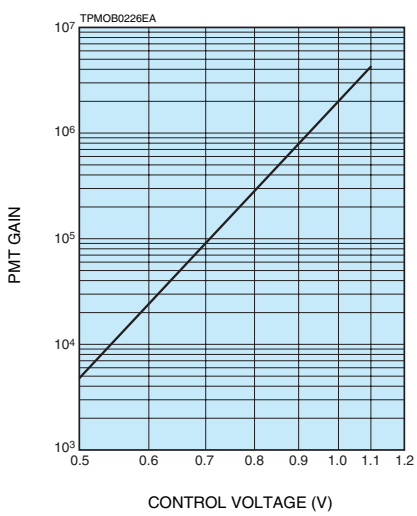
*1: At ±5 V input voltage, +1.0 V control voltage, and output current equal to dark current *2: At ±5 V input voltage
*3: Measured at the peak sensitivity wavelength *4: Control voltage = +1.0 V
*5: After 30 minutes storage in darkness. The actual output value in darkness is the sum of dark current and offset voltage.
*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.
*8: No condensation

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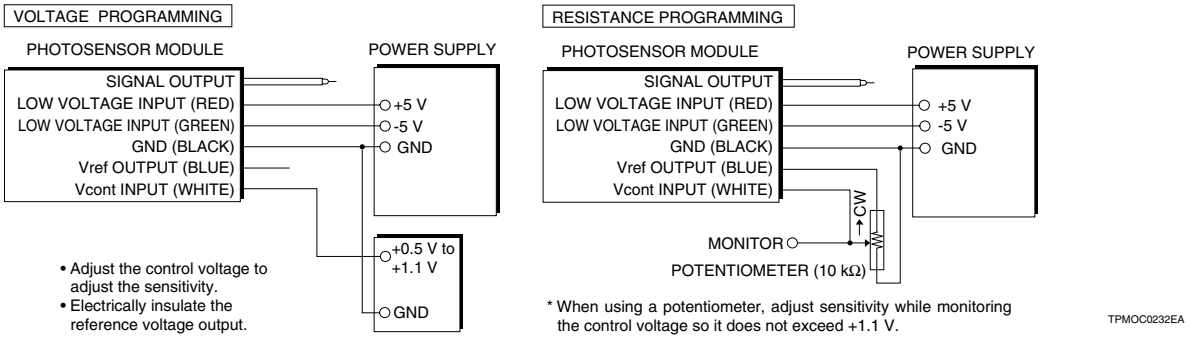
Characteristics (Anode radiant sensitivity, PMT gain)



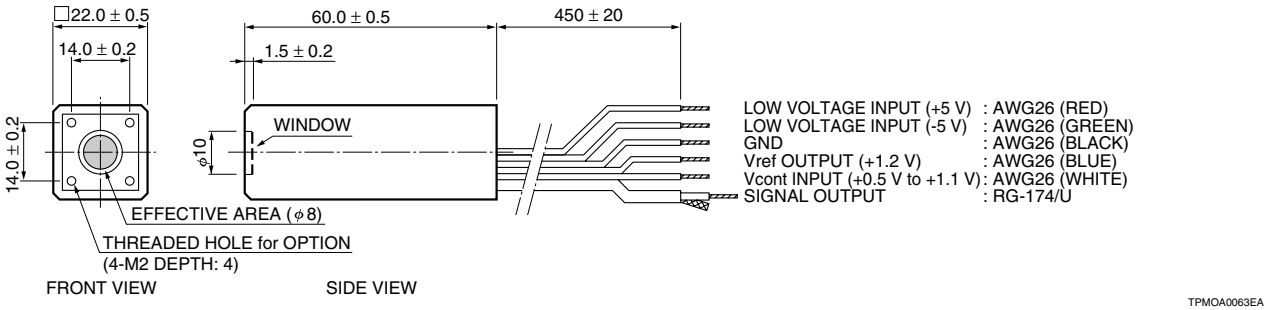




Sensitivity Adjustment Method

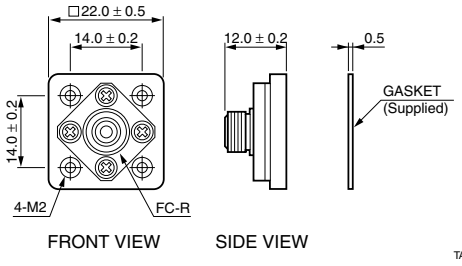


Dimensional Outlines (Unit: mm)

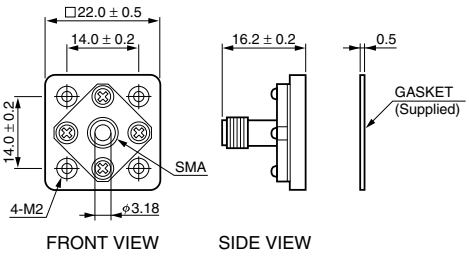


Options (Optical Fiber Adapter) (Unit: mm)

E5776 (FC Type)



E5776-51 (SMA Type)



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Metal Package PMT

Photosensor Modules H10723 Series



The H10723 series is a photosensor module containing a metal package PMT, a low-power consumption high-voltage power supply circuit, and a low-noise amplifier. The amplifier converts the PMT current output to a voltage output so that signal can be easily processed. Also, the amplifier is connected close to the PMT anode output pin to make the signal less affected by external noise. The H10723 series covers a frequency bandwidth from DC to 200 kHz, which is wider than that for the H10722 series.

Four types of photocathodes are available, including a super bialkali photocathode that has higher sensitivity than conventional bialkali photocathodes, an ultra bialkali photocathode that offers even higher sensitivity, a multialkali photocathode with sensitivity extending to the near infrared region, and a red sensitivity enhanced multialkali photocathode.

Product Variations

Parameter	Spectral Response	Current-to-Voltage Conversion Factor*	Frequency Bandwidth*	Features
H10723-110	230 nm to 700 nm	0.1 V/µA	DC to 200 kHz	Super bialkali photocathode, high sensitivity in visible range
H10723-210	230 nm to 700 nm			Ultra bialkali photocathode, high sensitivity in visible range
H10723-01	230 nm to 870 nm			For visible to near IR range
H10723-20	230 nm to 920 nm			Infrared-extended multialkali photocathode with enhanced sensitivity

* The amplifier specification can be changed upon request. Feel free to contact our sales office.
This product can't be used at vacuum environment or reduced pressure environment.

Specifications

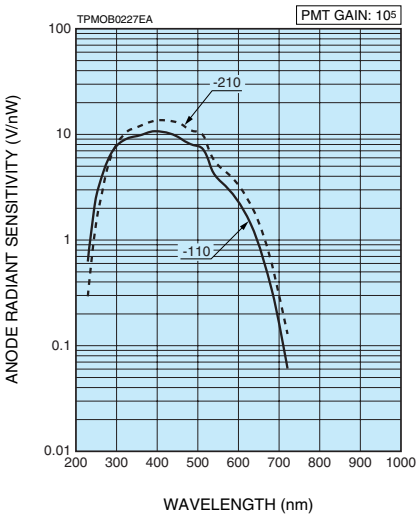
(at +25 °C)

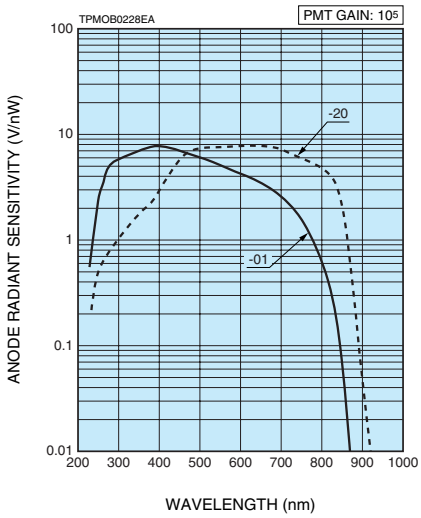
Parameter			H10723-110	H10723-210	H10723-01	H10723-20	Unit
Input Voltage			±4.5 to ±5.5				V
Max. Input Voltage			±5.5				V
Max. Input Current *1			+6.2 / -3.5				mA
Max. Output Signal Voltage *2			+4 (Load resistance 10 kΩ)				V
Max. Control Voltage			+1.1 (Input Impedance 1 MΩ)				V
Recommended Control Voltage Adjustment Range			+0.5 to +1.1 (Input Impedance 1 MΩ)				V
Effective Area			ϕ8				mm
Peak Sensitivity Wavelength			400	400	400	630	nm
Cathode	Luminous Sensitivity	Min.	80	100	100	350	µA/lm
		Typ.	105	135	200	500	
	Blue Sensitivity Index (CS 5-58)	Typ.	13.5	15.5	—	—	—
	Red / White Ratio	Typ.	—	—	0.2	0.45	—
	Radiant Sensitivity *3	Typ.	110	130	77	78	mA/W
Anode	Luminous Sensitivity *4	Min.	8.0×10^6	1.0×10^7	1.0×10^7	3.5×10^7	V/lm
		Typ.	2.1×10^7	2.7×10^7	4.0×10^7	1.0×10^8	
	Radiant Sensitivity *3 *4	Typ.	22	26	15	15	V/nW
	Voltage Output Depending on PMT Dark Current *4 *5	Typ.	0.1	0.1	0.1	1	mV
		Max.	1	1	1	10	
Current-to-Voltage Conversion Factor			0.1				V/µA
Output Offset Voltage		Typ.	±1				mV
Ripple Noise *4 *6 (peak to peak)		Max.	0.5				mV
Settling Time *7		Max.	10				s
Operating Ambient Temperature *8			+5 to +50				°C
Storage Temperature *8			-20 to +50				°C
Weight		Typ.	90				g

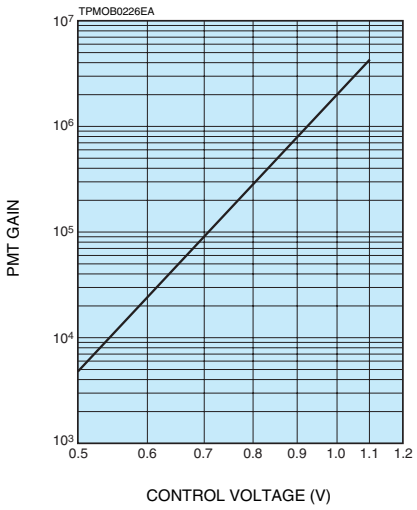
*1: At ±5 V input voltage, +1.0 V control voltage, and output current equal to dark current *2: At ±5 V input voltage
*3: Measured at the peak sensitivity wavelength *4: Control voltage = +1.0 V
*5: After 30 minutes storage in darkness. The actual output value in darkness is the sum of dark current and offset voltage.
*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.
*8: No condensation

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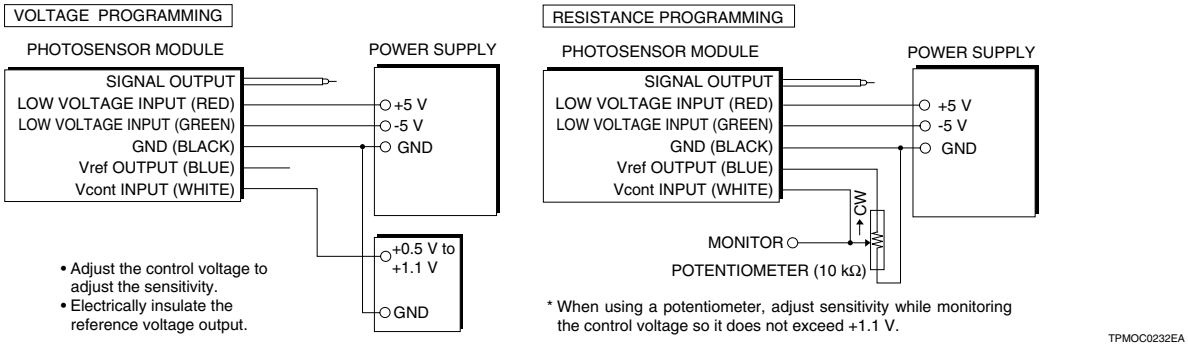
Characteristics (Anode radiant sensitivity, PMT gain)



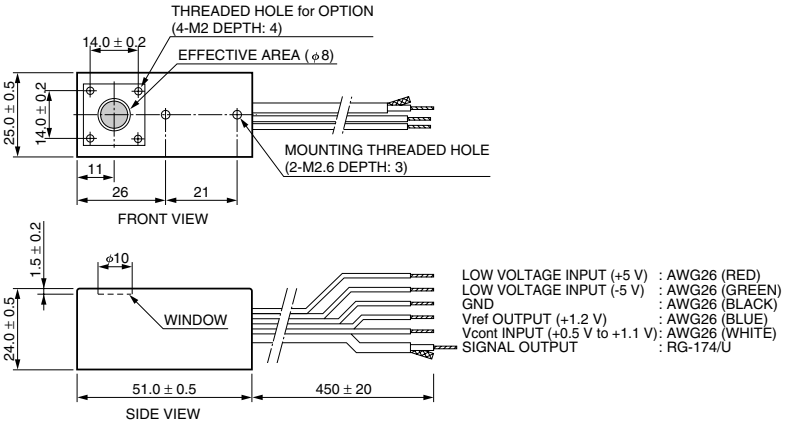




Sensitivity Adjustment Method

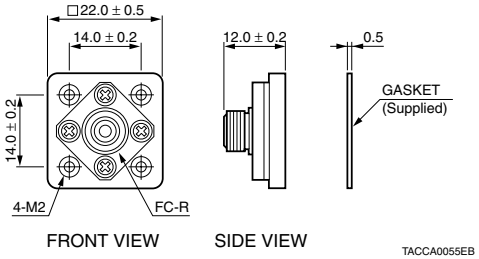


Dimensional Outlines (Unit: mm)

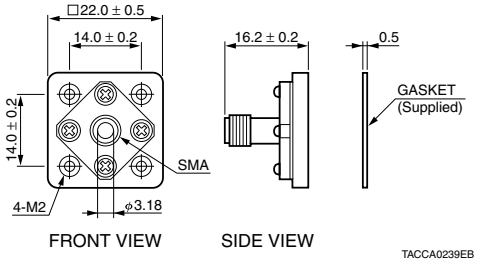


Options (Optical Fiber Adapter) (Unit: mm)

E5776 (FC Type)



E5776-51 (SMA Type)



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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
H9307-01	H9307-02	H9307-03	H9307-04	H9307-05	0.1 V/µA	DC to 200 kHz	consumption

* The amplifier specification can be changed upon request. Feel free to contact our sales office.
This product can't be used at vacuum environment or reduced pressure environment. Please pay attention when the H9306 series/H9307 series is used for measuring the light below 190 nm.

Specifications

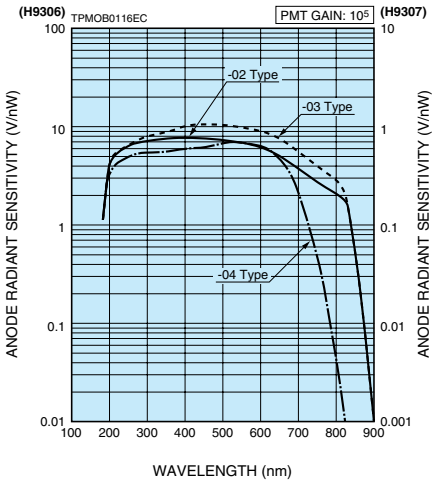
(at +25 °C)

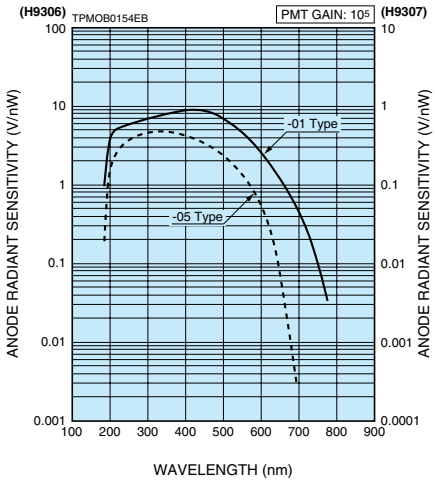
Parameter			H9306 / H9307 Series					Unit
Suffix			-01	-02	-03	-04	-05	—
Input Voltage			±11.5 to ±15.5					V
Max. Input Voltage			±18					V
Max. Input Current			+9 / -1 (H9306), +15 / -8 (H9307)					mA
Max. Control Voltage			+1.2 (Input Impedance: 1 MΩ)					V
Recommended Control Voltage Adjustment Range			+0.25 to +1.0					V
Effective Area			3.7 × 13.0					mm
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	1.2×10^9	2.0×10^9	7.0×10^8	3.0×10^8	
	Radiant Sensitivity *1 *2	Typ.	520	310	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 *5			+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	1.2×10^8	2.0×10^8	7.0×10^7	3.0×10^7	
	Radiant Sensitivity *1 *2	Typ.	52	31	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 *5			+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 *6 (peak to peak)		Max.	0.8					mV
Settling Time *7		Max.	10					s
Operating Ambient Temperature *8			+5 to +50					°C
Storage Temperature *8			-20 to +50					°C
Weight			110					g

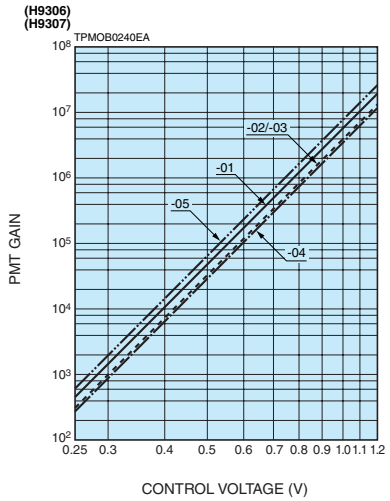
*1: Measured at the peak sensitivity wavelength *2: Control voltage = +1.0 V *3: After 30 minutes storage in darkness *4: Output of anode dark current
*5: At ±15 V input voltaget *6: Cable RG-174/U, Cable length 450 mm, Load resistance = 1 MΩ, Load capacitance = 22 pF
*7: The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V. *8: No condensation

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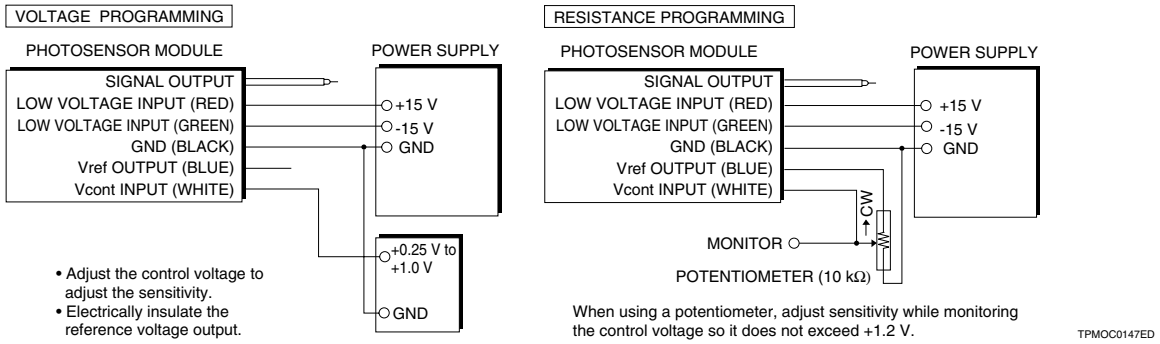
Characteristics (Anode radiant sensitivity, PMT gain)



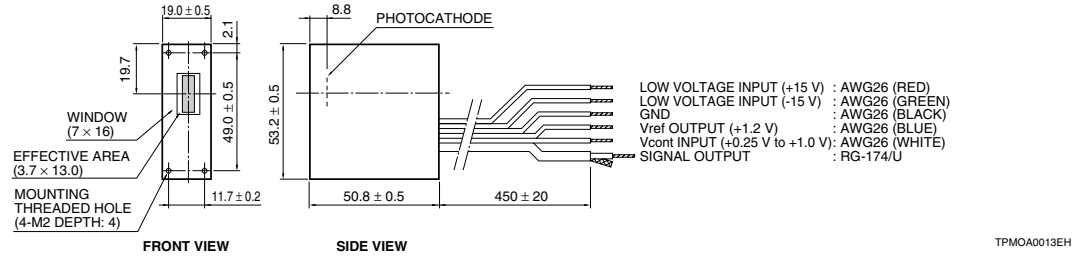




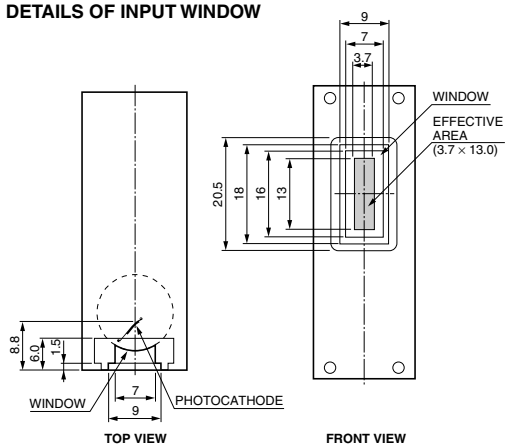
Sensitivity Adjustment Method



Dimensional Outlines (Unit: mm)



DETAILS OF INPUT WINDOW



Side-on PMT

Photosensor Modules H11462 Series



The H11462 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.

Product Variations

Type No.	Spectral Response	Current-to-Voltage Conversion Factor	Frequency Bandwidth	Features
H11462-011	185 nm to 710 nm	1 V/µA	DC to 20 kHz	For UV to visible range, low noise
H11462-021	185 nm to 900 nm			For UV to near IR range
H11462-031	185 nm to 900 nm			For UV to near IR range, high sensitivity
H11462-012	185 nm to 710 nm	0.1 V/µA	DC to 200 kHz	For UV to visible range, low noise
H11462-022	185 nm to 900 nm			For UV to near IR range
H11462-032	185 nm to 900 nm			For UV to near IR range, high sensitivity

* The amplifier specification can be changed upon request. Feel free to contact our sales office.
This product can't be used at vacuum environment or reduced pressure environment. Please pay attention when the H11462 series is used for measuring the light below 190 nm.

Specifications

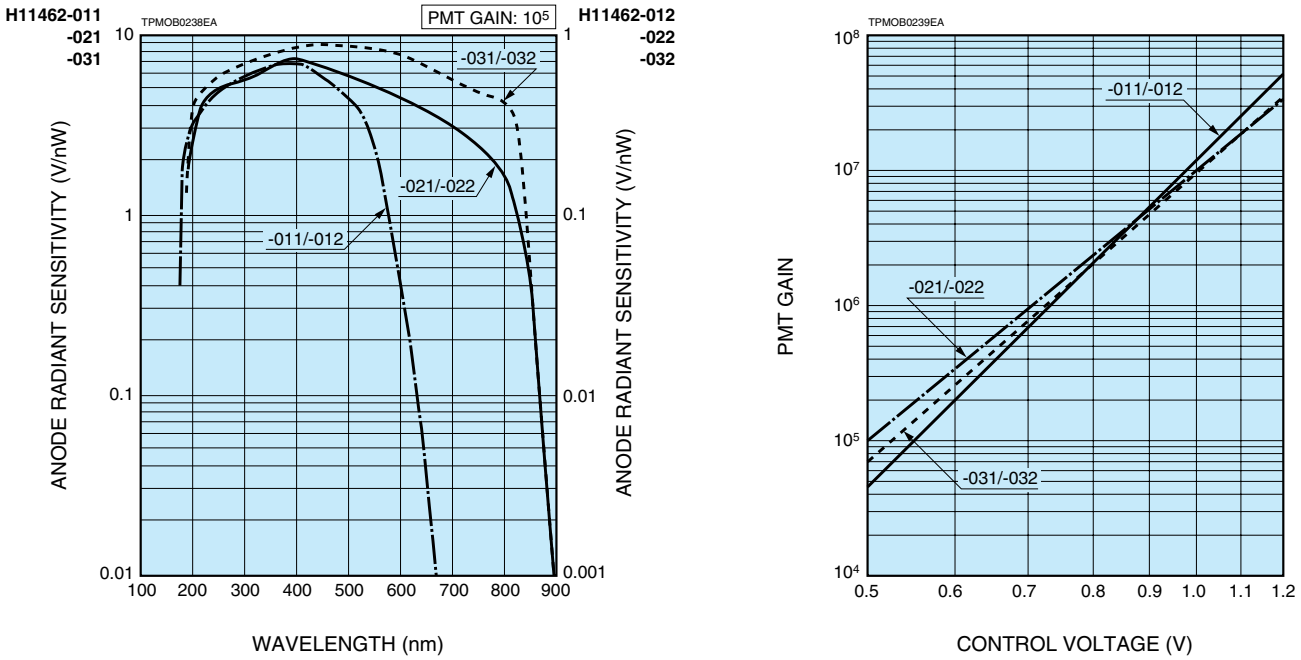
(at +25 °C)

Parameter			H11462 Series			Unit
Suffix			-011 / -012	-021 / -022	-031 / -032	—
Input Voltage			±4.5 to ±5.5			V
Max. Input Voltage			±6			V
Max. Input Current *1			+7 / -3 (-011/-021/-031), +11 / -7 (-012/-012/-032)			mA
Max. Control Voltage			+1.2 (Input Impedance 1 MΩ)			V
Recommended Control Voltage Adjustment Range			+0.5 to +1.1			V
Effective Area			4 × 20			mm
Peak Sensitivity Wavelength			410	400	450	nm
Cathode	Luminous Sensitivity	Min.	80	140	475	µA/lm
		Typ.	100	250	525	
	Blue Sensitivity Index (CS 5-58)	Typ.	8	—	—	—
	Red/White Ratio	Typ.	—	0.3	0.4	—
	Radiant Sensitivity *2	Typ.	70	74	90	mA/W
Suffix (with internal 20 kHz amp)			-011	-021	-031	
Anode	Luminous Sensitivity *3	Min.	1.0×10^9	4.0×10^8	3.0×10^9	V/lm
		Typ.	1.2×10^9	2.5×10^9	5.0×10^9	
	Radiant Sensitivity *2 *3	Typ.	840	740	855	V/nW
	Voltage Output Depending on PMT Dark Current *3 *4	Typ.	0.2	3	10	mV
		Max.	2	50	50	
Max. Output Signal Voltage *5			+4 (Load resistance 10 kΩ)			V
Current-to-Voltage Conversion Factor			1			V/µA
Suffix (with internal 200 kHz amp)			-012	-022	-032	
Anode	Luminous Sensitivity *3	Min.	1.0×10^8	4.0×10^7	3.0×10^8	V/lm
		Typ.	1.2×10^8	2.5×10^8	5.0×10^8	
	Radiant Sensitivity *2 *3	Typ.	84	74	85.5	V/nW
	Voltage Output Depending on PMT Dark Current *3 *4	Typ.	0.02	0.3	1	mV
		Max.	0.2	5	5	
Max. Output Signal Voltage *5			+4 (Load resistance 10 kΩ)			V
Current-to-Voltage Conversion Factor			0.1			V/µA
			H11462 series			
Offset Voltage		Typ.	±1			mV
Ripple Noise *3 *6 (peak to peak)		Max.	0.5			mV
Settling Time *7		Max.	10			s
Operating Ambient Temperature *8			+5 to +50			°C
Storage Temperature *8			-20 to +50			°C
Weight			225			g

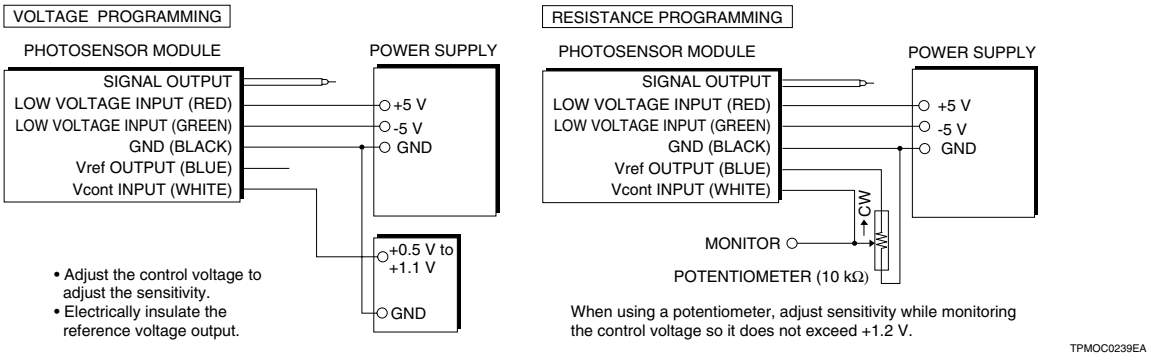
*1: At ±5 V input voltage, +1.0 V control voltage, and output current equal to dark current *2: Measured at the peak sensitivity wavelength
*3: Control voltage = +1.0 V *4: Output of anode dark current *5: At ±5 V input voltage
*6: Cable RG-174/U, Cable length 450 mm, Load resistance = 1 MΩ, Load capacitance = 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. *8: No condensation

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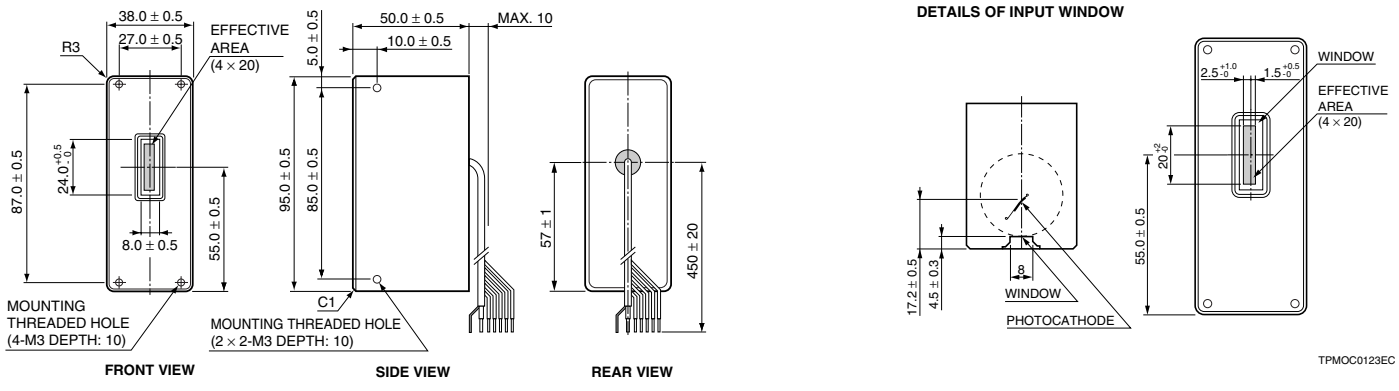
Characteristics (Anode radiant sensitivity, PMT gain)



Sensitivity Adjustment Method



Dimensional Outlines (Unit: mm)



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

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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. Compared to other PMT modules, the H7827 series has higher resistance to vibration and shock, making them suitable for portable or mobile measurement equipment.

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

* The amplifier specification can be changed upon request. Feel free to contact our sales office.
This product can't be used at vacuum environment or reduced pressure environment.

Specifications

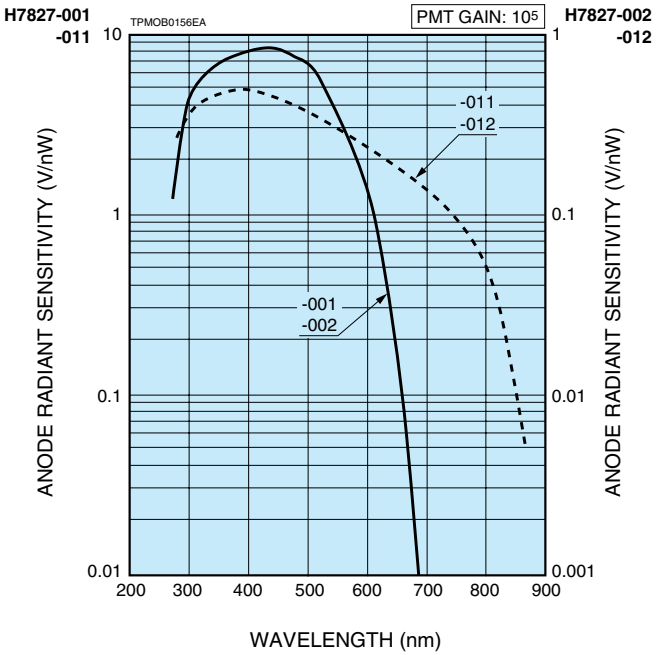
(at +25 °C)

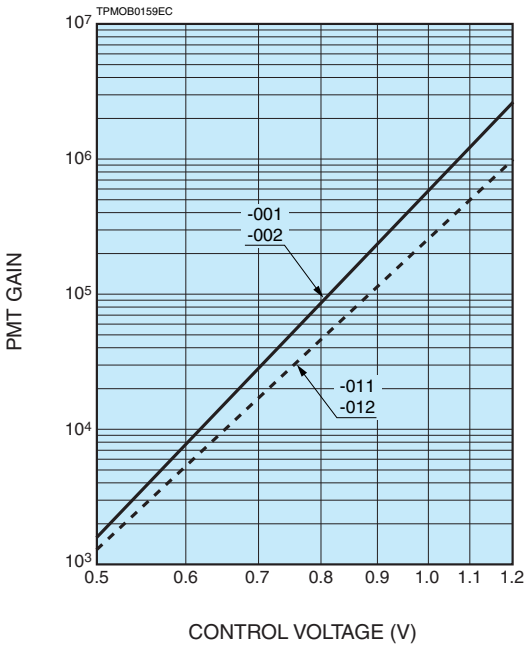
Parameter			H7827 Series		Unit
Suffix			-001 / -002	-011 / -012	—
Input Voltage			±11.5 to ±15.5		V
Max. Input Voltage			±18		V
Max. Input Current			+45 / -1 (-001/-011), +50 / -8 (-002/-012)		mA
Max. Control Voltage			+1.2 (Input Impedance 100 kΩ)		V
Recommended Control Voltage Adjustment Range			+0.5 to +1.1		V
Effective Area			φ15		mm
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 *5			+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 *5			+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 *6 (peak to peak)		Max.	0.6		mV
Settling Time *7		Max.	0.2		s
Operating Ambient Temperature *8			+5 to +45		°C
Storage Temperature *8			-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: At ±15 V input voltage *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 *8: No condensation.

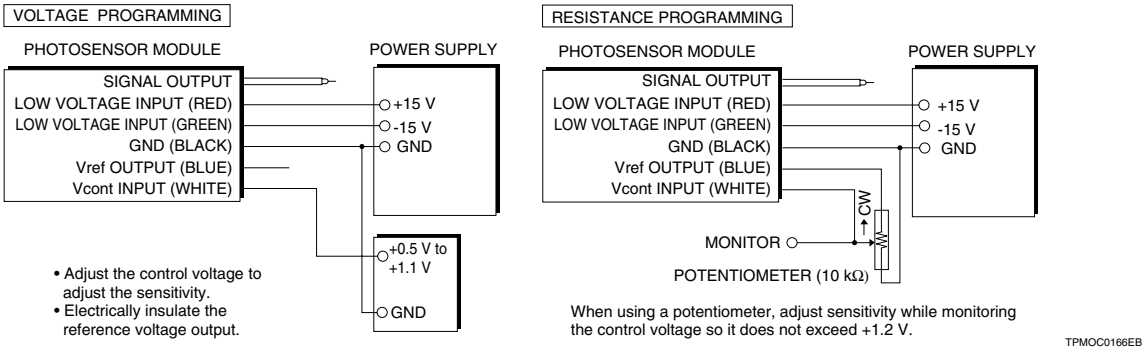
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Characteristics (Anode radiant sensitivity, PMT gain)

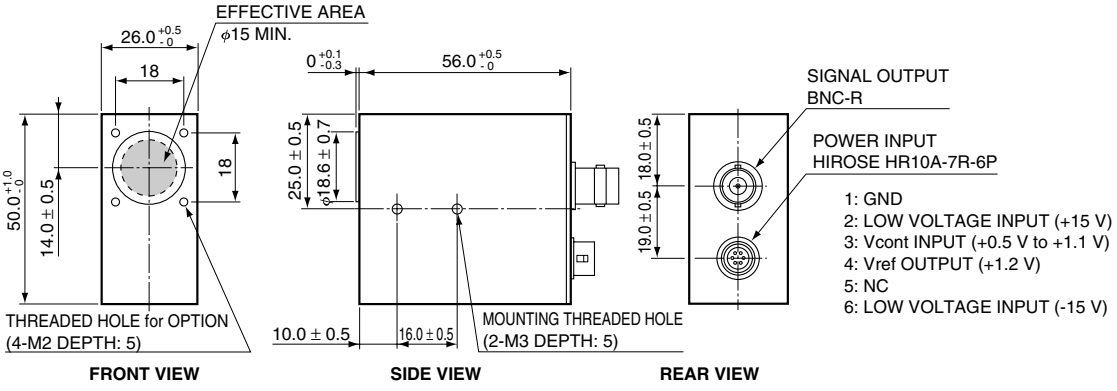




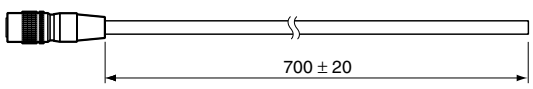
Sensitivity Adjustment Method



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)

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Head-on PMT

Photosensor Modules H10492 Series



The H10492 series photosensor modules incorporate a 25-mm (1") diameter head-on photomultiplier tube, a high-voltage power supply circuit and a low noise amplifier. 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, DC to 200 kHz or DC to 8 MHz. 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
H10492-001	300 nm to 650 nm	1 V/µA	DC to 20 kHz	For visible range
H10492-011	300 nm to 850 nm			For visible to near IR range
H10492-002	300 nm to 650 nm	0.1 V/µA	DC to 200 kHz	For visible range
H10492-012	300 nm to 850 nm			For visible to near IR range
H10492-003	300 nm to 650 nm		DC to 8 MHz	For visible range
H10492-013	300 nm to 850 nm			For visible to near IR range

* The amplifier specification can be changed upon request. Feel free to contact our sales office.
This product can't be used at vacuum environment or reduced pressure environment.

Specifications

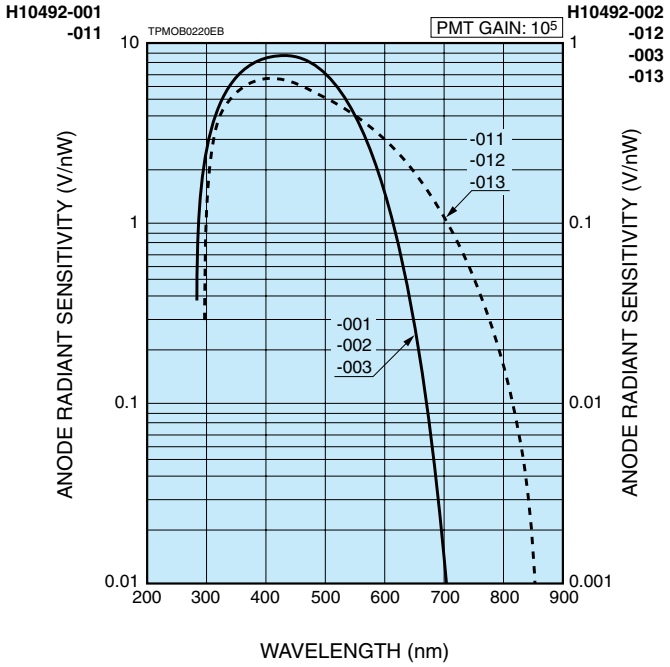
(at +25 °C)

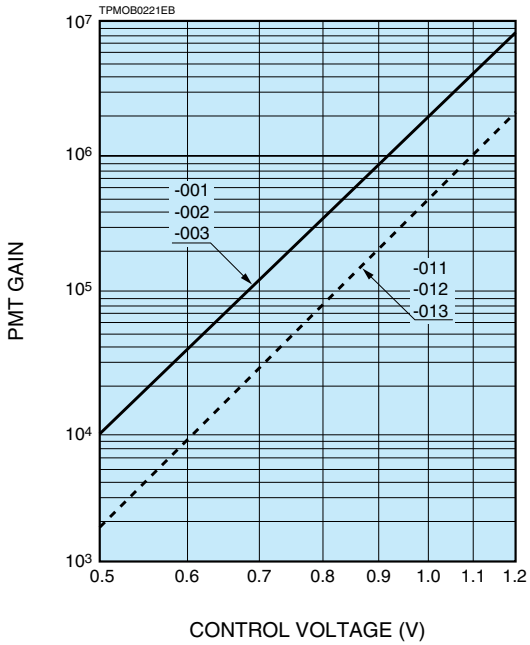
Parameter			H10492 Series		Unit
Suffix			-001 / -002 / -003	-011 / -012 / -013	—
Input Voltage			±11.5 to ±15.5		V
Max. Input Voltage			±18		V
Max. Input Current *1			+4 / -1 (-001/-011), +11 / -8 (-002/-012), +24 / -21 (-003/-013)		mA
Max. Control Voltage			+1.2 (Input Impedance 1 MΩ)		V
Recommended Control Voltage Adjustment Range *2			+0.5 to +1.1 (Input Impedance 1 MΩ)		V
Effective Area			φ22		mm
Peak Sensitivity Wavelength			420		nm
Cathode	Luminous Sensitivity	Min.	60	80	µA/lm
		Typ.	90	150	
	Blue Sensitivity Index (CS 5-58)	Typ.	10.5	—	—
	Red / White Ratio	Typ.	—	0.2	—
	Radiant Sensitivity *3	Typ.	85	64	mA/W
Suffix (with internal 20 kHz amp)			-001	-011	
Anode	Luminous Sensitivity *4	Min.	4.0×10^7	2.0×10^7	V/lm
		Typ.	1.8×10^8	7.5×10^7	
	Radiant Sensitivity *3 *4	Typ.	170	32	V/nW
	Voltage Output Depending on PMT Dark Current *4 *5	Typ.	3	3	mV
		Max.	20	20	
Max. Output Signal Voltage *6			+10 (Load resistance 10 kΩ)		V
Current-to-Voltage Conversion Factor			1		V/µA
Suffix (with internal 200 kHz / 8 MHz amp)			-002 / -003	-012 / -013	
Anode	Luminous Sensitivity *4	Min.	4.0×10^6	2.0×10^6	V/lm
		Typ.	1.8×10^7	7.5×10^6	
	Radiant Sensitivity *3 *4	Typ.	17	3.2	V/nW
	Voltage Output Depending on PMT Dark Current *4 *5	Typ.	0.3	0.3	mV
		Max.	2	2	
Max. Output Signal Voltage *6			-002 / -012: +10 (Load resistance 10 kΩ) -003 / -013: +10 (Load resistance 500 Ω), +5 (Load resistance 50 Ω)		V
Current-to-Voltage Conversion Factor			0.1		V/µA
			H10492 series		
Output Offset Voltage		Typ.	±1		mV
Ripple Noise *4 *7 *8 (peak to peak)		Max.	0.6 (-001 / -002 / -011 / -012), 0.8 (-003 / -013)		mV
Settling Time *9		Max.	10		s
Operating Ambient Temperature *10			+5 to +50		°C
Storage Temperature *10			-20 to +50		°C
Weight		Typ.	170 (-001 / -002 / -003), 180 (-011 / -012 / -013)		g

*1: At ±15 V input voltage, +1.0 V control voltage, and output current equal to dark current *2: DAC (I^2C interface) can be installed in the module, please specify when ordering. *3: Measured at the peak sensitivity wavelength *4: Control voltage = +1.0 V *5: After 30 minutes storage in darkness. The actual output value in darkness is the sum of dark current and offset voltage. *6: At ±15 V input voltage
*7: Cable RG-174/U, Cable length 450 mm, Load resistance = 1 MΩ, Load capacitance = 22 pF *8: -003,-013 Amplifier noise = 8 mV typ. (peak to peak)
*9: 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. *10: No condensation.

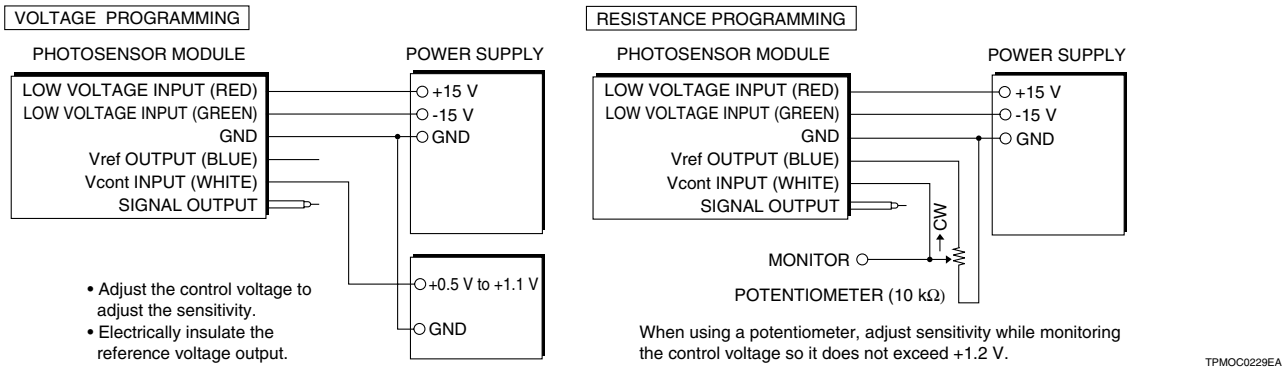
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Characteristics (Cathode radiant sensitivity, PMT gain)

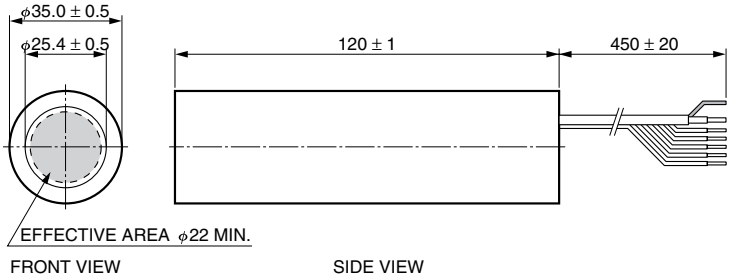




Sensitivity Adjustment Method



Dimensional Outlines (Unit: mm)



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

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Head-on PMT

Photosensor Modules H10493 Series



The H10493 series photosensor modules incorporate a 28 mm (1-1/8") diameter head-on photomultiplier tube, a high voltage power supply, and a low noise amplifier. Since it has a wide photosensitive area of 25 mm diameter, light can be collected efficiently. 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, DC to 200 kHz or DC to 8 MHz. Photomultiplier tubes with different spectral response characteristics are provided for measurement in the visible range or UV to near IR range.

Product Variations

Type No.	Spectral Response	Current-to-Voltage Conversion Factor*	Frequency Bandwidth*	Features
H10493-001	300 nm to 650 nm	1 V/µA	DC to 20 kHz	For visible range
H10493-011	185 nm to 850 nm			For UV to near IR range
H10493-002	300 nm to 650 nm	0.1 V/µA	DC to 200 kHz	For visible range
H10493-012	185 nm to 850 nm			For UV to near IR range
H10493-003	300 nm to 650 nm		DC to 8 MHz	For visible range
H10493-013	185 nm to 850 nm			For UV to near IR range

* The amplifier specification can be changed upon request. Feel free to contact our sales office.
This product can't be used at vacuum environment or reduced pressure environment. Please pay attention when the H10493-011/-012/-013 is used for measuring the light below 190 nm.

Specifications

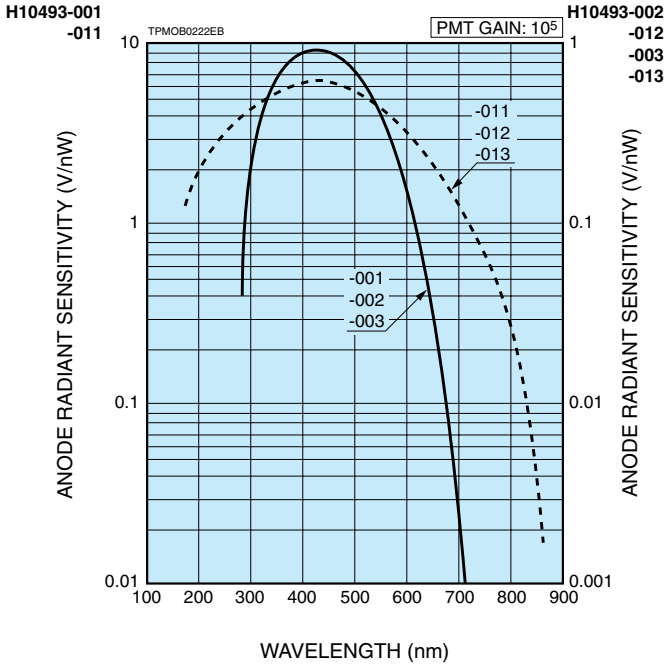
(at +25 °C)

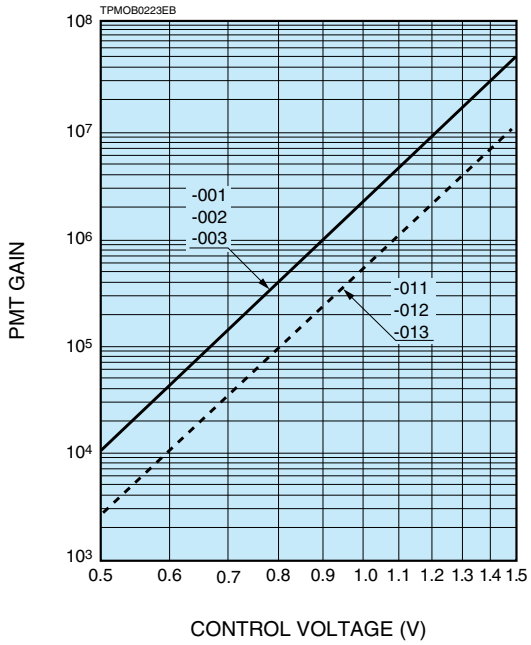
Parameter			H10493 Series		Unit
Suffix			-001 / -002 / -003	-011 / -012 / -013	—
Input Voltage			±11.5 to ±15.5		V
Max. Input Voltage			±18		V
Max. Input Current *1			+4 / -1 (-001/-011), +11 / -8 (-002/-012), +24 / -21 (-003/-013)		mA
Max. Control Voltage			+1.5 (Input Impedance 1 MΩ)		V
Recommended Control Voltage Adjustment Range *2			+0.5 to +1.4 (Input Impedance 1 MΩ)		V
Effective Area			φ25		mm
Peak Sensitivity Wavelength			420		nm
Cathode	Luminous Sensitivity	Min.	60	80	µA/lm
		Typ.	95	150	
	Blue Sensitivity Index (CS 5-58)	Typ.	11	—	—
	Red / White Ratio	Typ.	—	0.2	—
	Radiant Sensitivity *3	Typ.	88	64	mA/W
Suffix (with internal 20 kHz amp)			-001	-011	
Anode	Luminous Sensitivity *4	Min.	5.0×10^7	2.0×10^7	V/lm
		Typ.	2.0×10^8	8.0×10^7	
	Radiant Sensitivity *3 *4	Typ.	180	34	V/nW
	Voltage Output Depending on PMT Dark Current *4 *5	Typ.	2	3	mV
		Max.	10	15	
Max. Output Signal Voltage *6			+10 (Load resistance 10 kΩ)		V
Current-to-Voltage Conversion Factor			1		V/µA
Suffix (with internal 200 kHz / 8 MHz amp)			-002 / -003	-012 / -013	
Anode	Luminous Sensitivity *4	Min.	5.0×10^6	2.0×10^6	V/lm
		Typ.	2.0×10^7	8.0×10^6	
	Radiant Sensitivity *3 *4	Typ.	18	3.4	V/nW
	Voltage Output Depending on PMT Dark Current *4 *5	Typ.	0.2	0.3	mV
		Max.	1	1.5	
Max. Output Signal Voltage *6			-002 / -012: +10 (Load resistance 10 kΩ) -003 / -013: +10 (Load resistance 500 Ω), +5 (Load resistance 50 Ω)		V
Current-to-Voltage Conversion Factor			0.1		V/µA
			H10493 series		
Output Offset Voltage		Typ.	±1		mV
Ripple Noise *4 *7 *8 (peak to peak)		Max.	0.6 (-001 / -002 / -011 / -012), 0.8 (-003 / -013)		mV
Settling Time *9		Max.	10		s
Operating Ambient Temperature *10			+5 to +50		°C
Storage Temperature *10			-20 to +50		°C
Weight		Typ.	270		g

*1: At ±15 V input voltage, +1.0 V control voltage, and output current equal to dark current *2: DAC (I^2C interface) can be installed in the module, please specify when ordering. *3: Measured at the peak sensitivity wavelength *4: Control voltage = +1.0 V *5: After 30 minutes storage in darkness. The actual output value in darkness is the sum of dark current and offset voltage. *6: At ±15 V input voltage
*7: Cable RG-174/U, Cable length 450 mm, Load resistance = 1 MΩ, Load capacitance = 22 pF *8: -003,-013 Amplifier noise = 8 mV typ. (peak to peak)
*9: 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. *10: No condensation.

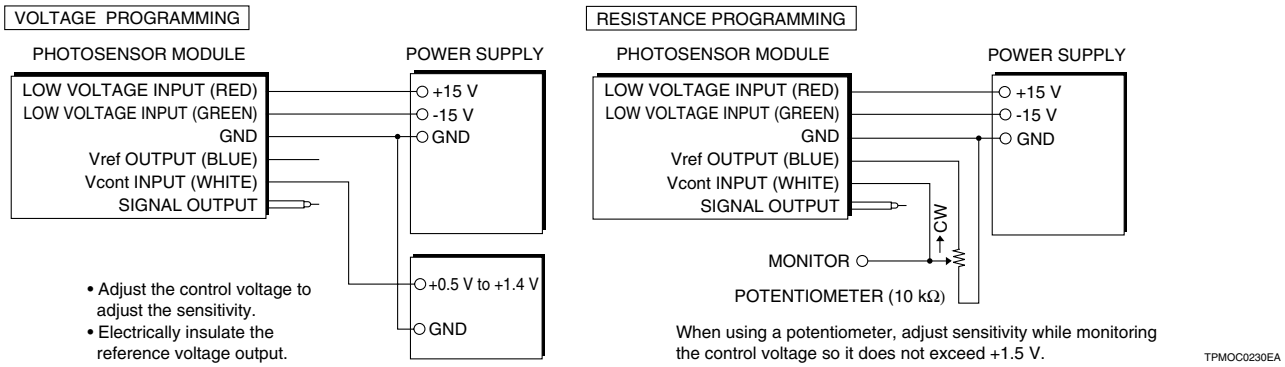
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Characteristics (Cathode radiant sensitivity, PMT gain)

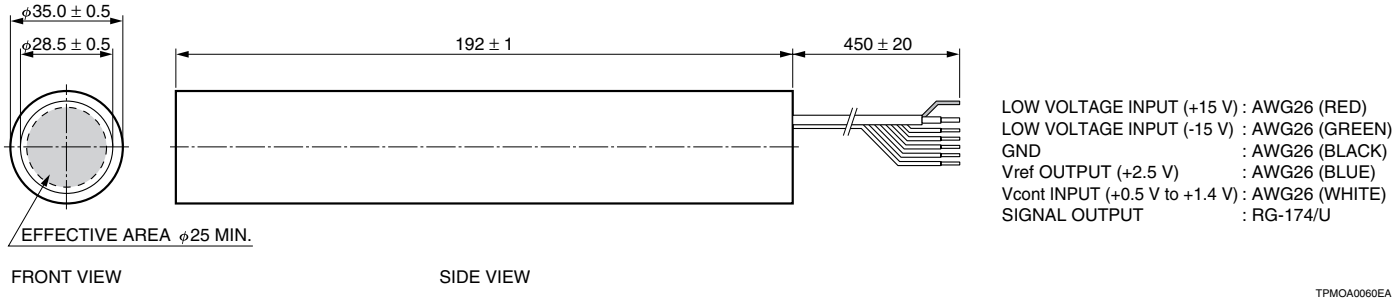




Sensitivity Adjustment Method



Dimensional Outlines (Unit: mm)



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

TPMOA0060EA

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Metal Package PMT with Gate Function

Photosensor Modules H11526 Series



The H11526 series is a photosensor module that allows gate operation. 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, 10 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.

Product Variations

Parameter	Spectral Response	Features
H11526-110-NN / H11526-110-NF	230 nm to 700 nm	Super bialkali photocathode, High sensitivity in visible range
H11526-01-NN / H11526-01-NF	230 nm to 870 nm	For UV to near IR range
H11526-20-NN / H11526-20-NF	230 nm to 920 nm	Extended red multialkali photocathode with enhanced sensitivity

Gate Mode NN: Normally ON
NF: Normally OFF

This product can't be used at vacuum environment or reduced pressure environment.

Specifications

(at +25 °C)

Parameter			H11526 Series		Unit
Suffix			-110-NN / -01-NN / -20-NN	-110-NF / -01-NF / -20-NF	—
Gate Mode	Mode		Normally ON	Normally OFF	—
	Gate Width (FWHM)		100 ns to DC		—
	Rise Time		8	70	ns
	Fall Time		70	8	ns
	Repetition Rate	Max.	10		kHz
	Switching Ratio		10^6		—
	Switching Noise *1	Max.	30		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)		—
	Input Impedance		10		kΩ
	Pulse Width		20 ns to DC		—

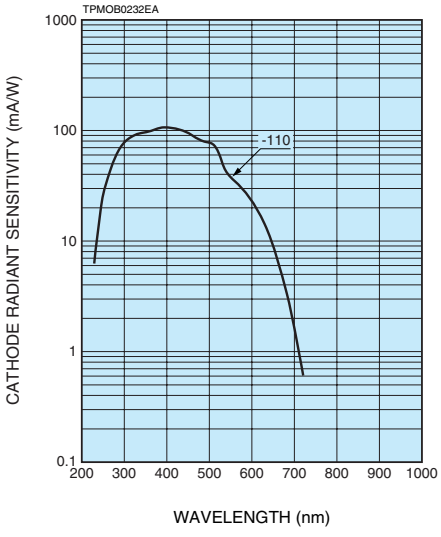
*1: Load resistance = 50 Ω (peak to peak)

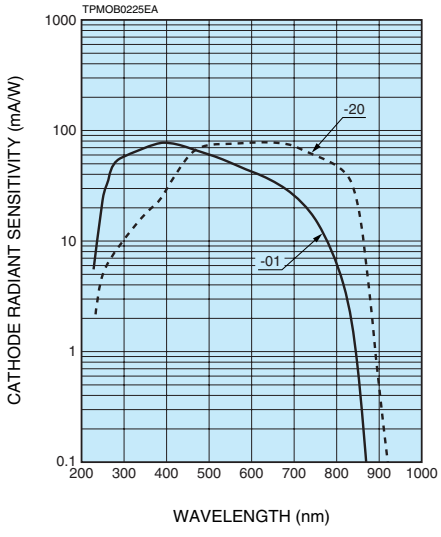
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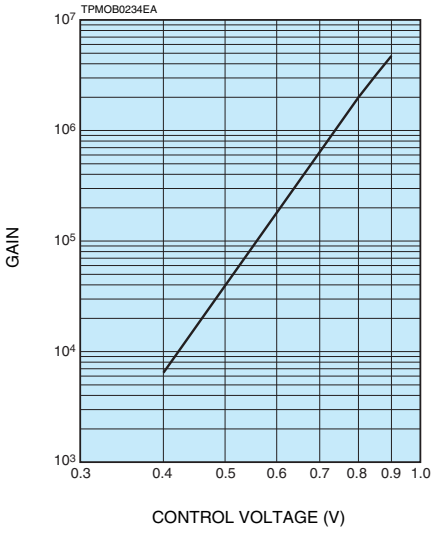
Parameter			H11526 Series			Unit
Suffix			-110-NN / -110-NF	-01-NN / -01-NF	-20-NN / -20-NF	—
Input Voltage			+14.5 to +15.5			V
Max. Input Voltage			+16			V
Max. Input Current			60			mA
Max. Surge Current			300			mA
Max. Output Signal Current			100			μA
Pulse Linearity (±5 % Deviation) *2			30			mA
Max. Control Voltage			+0.9 (Input Impedance 10 kΩ)			V
Recommended Control Voltage Adjustment Range			+0.4 to +0.9 (Input Impedance 10 kΩ)			V
Effective Area			ϕ8			mm
Peak Sensitivity Wavelength			400	400	630	nm
Cathode	Luminous Sensitivity	Min.	80	100	350	μA/lm
		Typ.	105	200	500	
	Blue Sensitivity Index (CS 5-58)	Typ.	13.5	—	—	—
	Red / White Ratio	Typ.	—	0.2	0.45	—
	Radiant Sensitivity *3	Typ.	110	77	78	mA/W
Anode	Luminous Sensitivity *2	Min.	80	100	350	A/lm
		Typ.	210	400	1000	
	Radiant Sensitivity *2 *3	Typ.	2.2×10^5	1.5×10^5	1.5×10^5	A/W
	Dark Current *2 *4	Typ.	1	1	10	nA
		Max.	10	10	100	
Time Response *2	Rise Time	Typ.	0.57			ns
	Transit Time	Typ.	2.7			ns
	T.T.S.	Typ.	0.2			ns
Ripple Noise *2 *5 (peak to peak)		Max.	5			mV
Settling Time *6		Max.	2			s
Operating Ambient Temperature *7			+5 to +45			°C
Storage Temperature *7			-20 to +50			°C
Weight			105			g

*2: Control voltage = +0.8 V
*3: Measured at the peak sensitivity wavelength
*4: After 30 minutes storage in darkness.
*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 +0.8 V to +0.4 V.
*7: No condensation

Characteristics (Cathode radiant sensitivity, Gain)



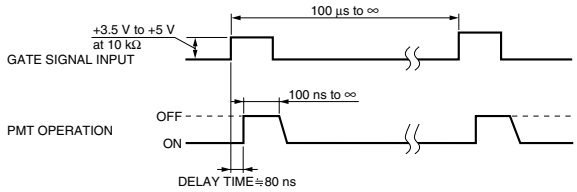




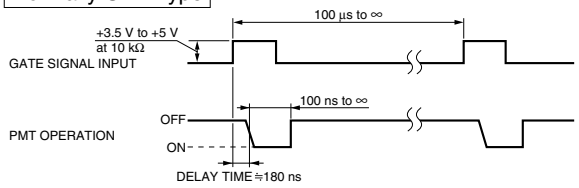
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Gate Timing Chart

Normally ON Type



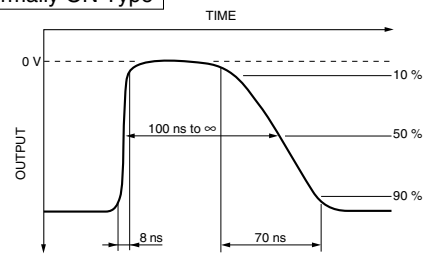
Normally OFF Type



TPMOC0200EA

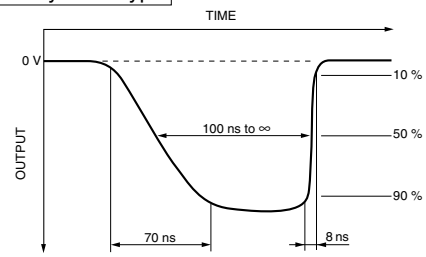
Output Examples

Normally ON Type



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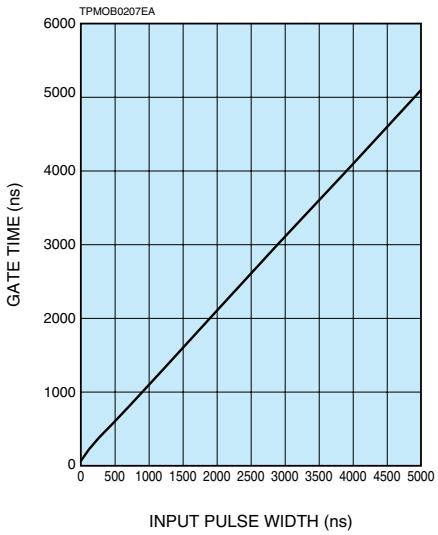
Normally OFF Type



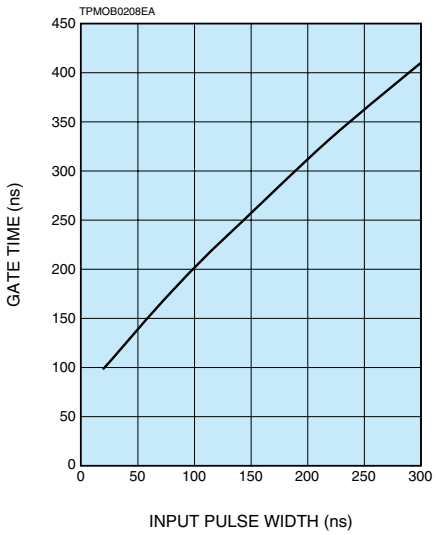
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Gate Time Characteristics

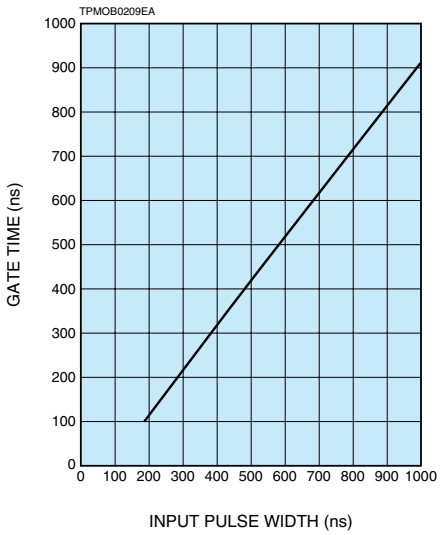
Normally ON Type



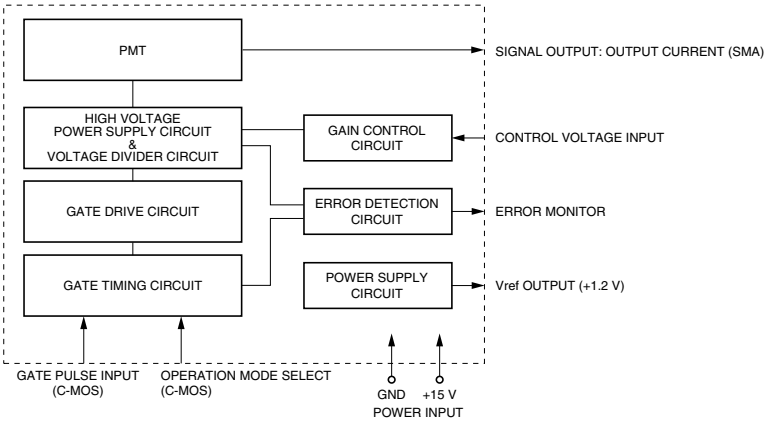
Normally ON Type closeup



Normally OFF Type



Block Diagram

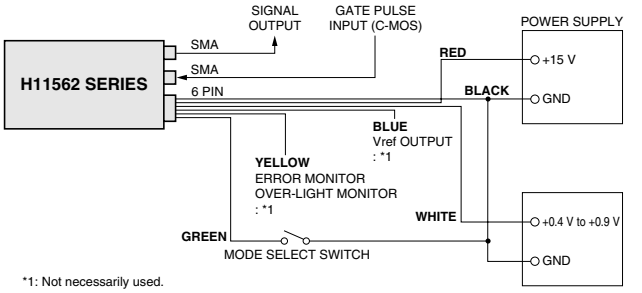


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Sensitivity Adjustment Method

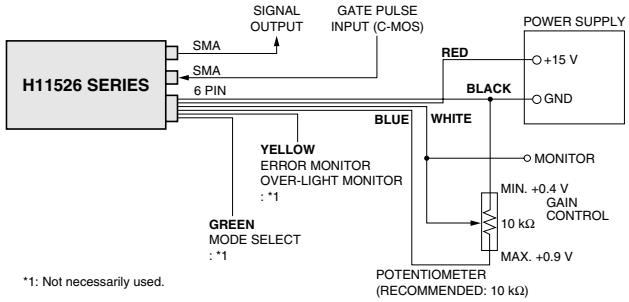
Voltage Programming



*1: Not necessarily used.

TPMOC0236EA

Resistance Programming

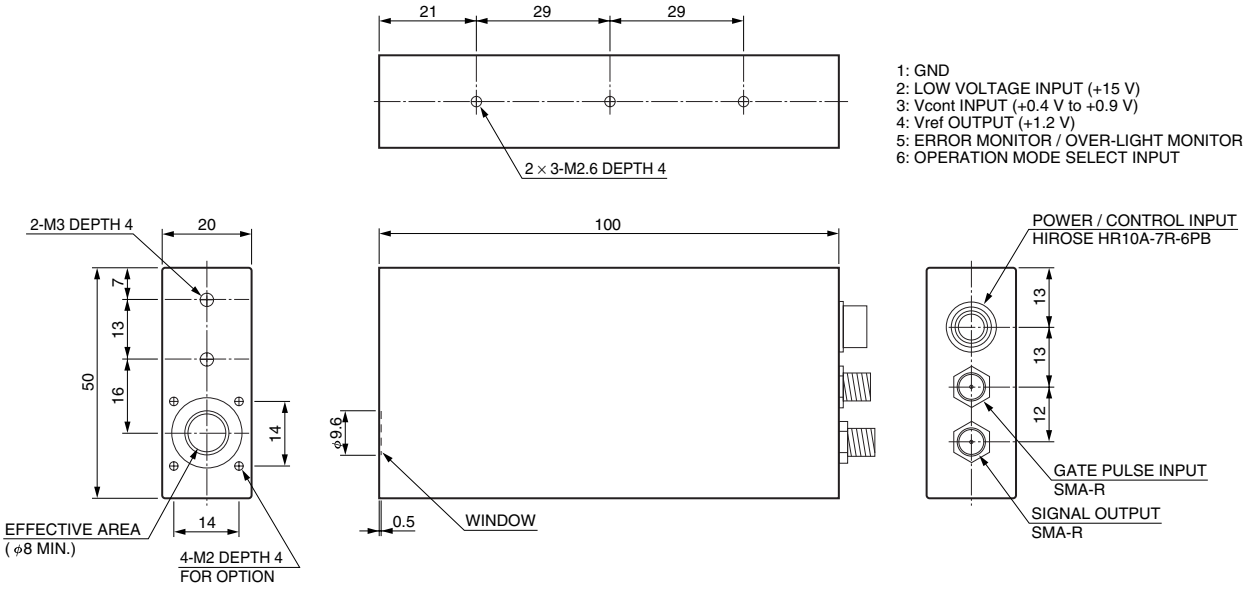


*1: Not necessarily used.

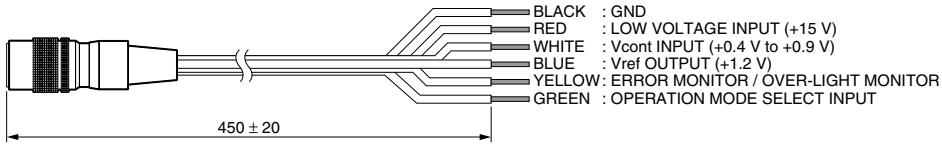
When using a potentiometer, adjust sensitivity while monitoring the control voltage so it does not exceed +0.9 V.

TPMOC0237EA

Dimensional Outlines (Unit: mm)



Power cable with connector (HIROSE HR10A-7P-6S) is supplied with H11526 series



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Metal package PMT

Photon Counting Head H10682 Series



The H10682 series is a photon counting head device 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 discrimination level are preset to optimum values, allowing photon counting measurement by just connecting a +5 V supply.

The H10682-110 has the super bialkali (SBA) photocathode and the H10682-210 has the ultra bialkali (UBA) photocathode, so they have higher sensitivity than conventional photon counting heads.

The H10682 series has also over light detection function to output a signal at the state that an output count falls by excessive incident light. By this signal, measurement data can be judged that it is normal or not.

Product Variations

Type No.	Spectral Response	Features
H10682-110	230 nm to 700 nm	Super Bialkali Photocathode, high sensitivity in visible range
H10682-210	230 nm to 700 nm	Ultra Bialkali Photocathode, high sensitivity in visible range
H10682-01	230 nm to 870 nm	Multialkali Photocathode, For UV to near IR range

This product can't be used at vacuum environment or reduced pressure environment.

Specifications

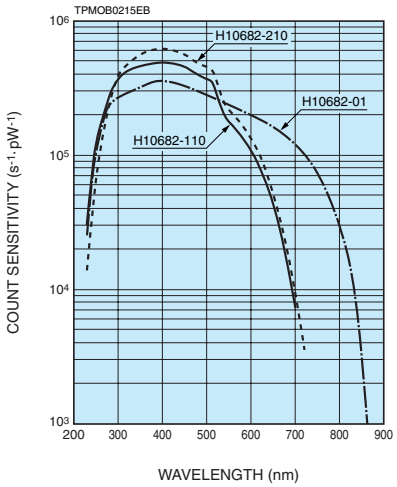
(at 25 °C)

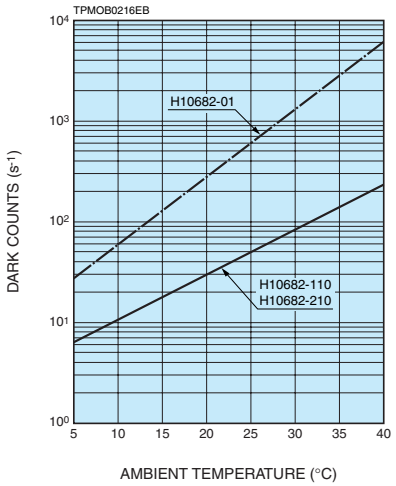
Parameter			H10682-110	H10682-210	H10682-01	Unit
Input Voltage			+4.75 to +5.25			V
Max. Input Voltage			+6			V
Max. Input Current			40			mA
Effective Area			ϕ8			mm
Peak Sensitivity Wavelength			400			nm
Count Sensitivity	Typ.	300 nm	3.7×10^5	3.9×10^5	2.7×10^5	$s^{-1} \cdot pW^{-1}$
		400 nm	4.9×10^5	6.1×10^5	3.6×10^5	
		500 nm	3.7×10^5	4.6×10^5	2.8×10^5	
		600 nm	1.1×10^5	1.3×10^5	2.0×10^5	
		700 nm	7.7×10^3	9.1×10^3	1.2×10^5	
		800 nm	—	—	3.0×10^4	
Count Linearity *1			5.0×10^6			s^{-1}
Dark Count *2		Typ.	50	50	600	s^{-1}
		Max.	100	100	1000	
Pulse-pair Resolution			20			ns
Output Pulse Width			10			ns
Output Pulse Height	50 Ω Load	Min.	+2			V
		Typ.	+2.2			
	Un-terminated	Min.	+4			
		Typ.	+4.4			
Signal Output Logic			Positive logic			—
Recommended Load Resistance			50			Ω
Over Light Detection Output *3	High Level	Min.	+3.5			V
	Low Level	Max.	+0.5			
Operating Ambient Temperature *4			+5 to +40			°C
Storage Temperature *4			-20 to +50			°C
Weight			47			g

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

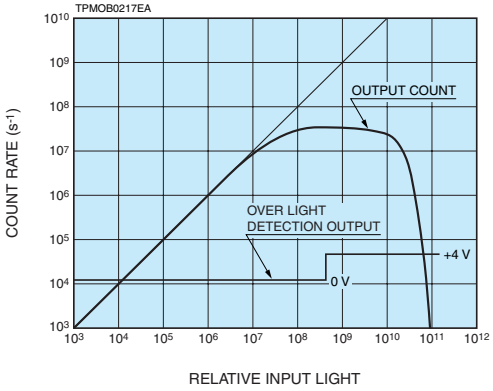
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Characteristics (Count sensitivity, Dark count)

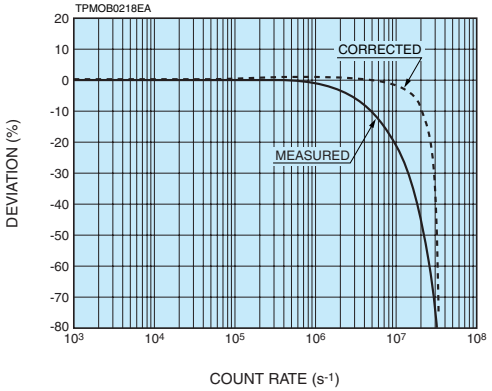




●Count Rate Linearity and Over Light Detection Output



●Count Rate Linearity Correction

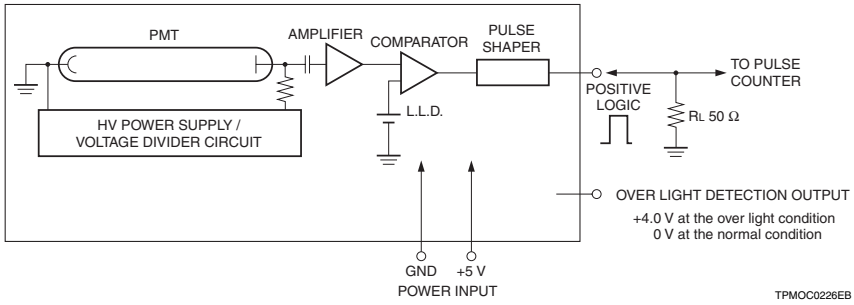


Correction Formula

$$N = \frac{M}{1-Mt}$$

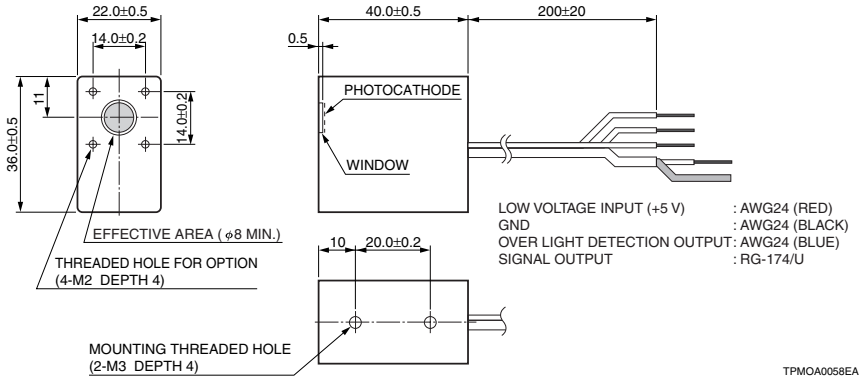
N: Real Count Rate (s^{-1})
M: Measured Count Rate (s^{-1})
t: Pulse Pair Resolution (s)

Block Diagram



TPMOC0226EB

Dimensional Outlines (Unit: mm)

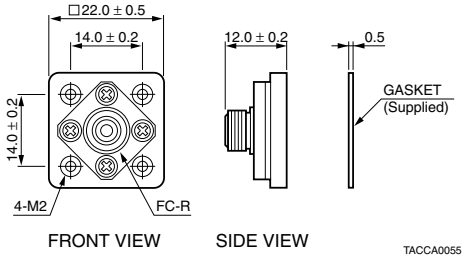


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Options

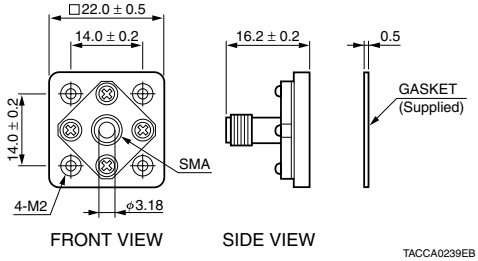
(Optical Fiber Adapter) (Unit: mm)

E5776 (FC Type)



TACCA0055EB

E5776-51 (SMA Type)



TACCA0239EB

Metal package PMT with Cooler

Photon Counting Head H7421 Series



Heatsink with fan (A7423) sold separately

The H7421 series is a photon counting head device 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

This product can't be used at vacuum environment or reduced pressure environment.

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	Typ.	420 nm	4.7×10^5	6.5×10^4	$s^{-1} \cdot pW^{-1}$
		550 nm	7.6×10^5	2.1×10^5	
		800 nm	—	3.9×10^5	
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

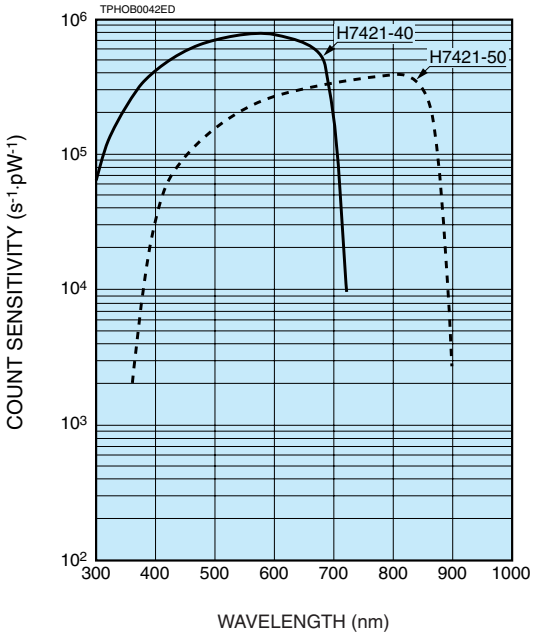
Cooling Specifications

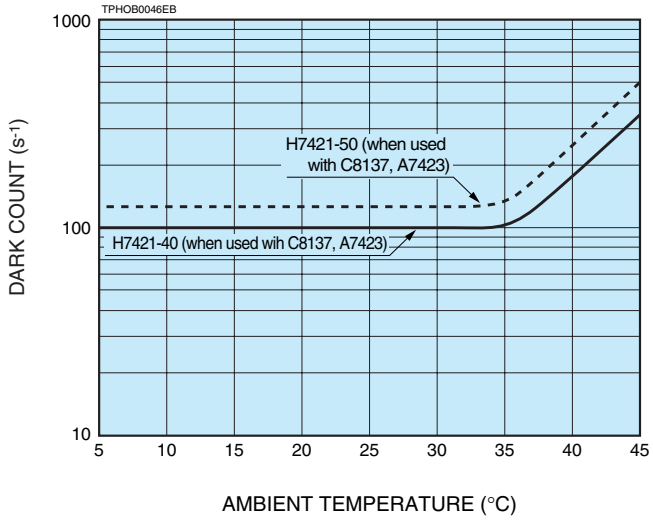
Parameter	H7421-40 / H7421-50	Unit
Cooling Method	Thermoelectric cooling	—
Max. Cooling Temperature (ΔT) *6	35	°C
Cooling Time *6	Approx. 5	min

*6: Input current to thermoelectric cooler = 2 A

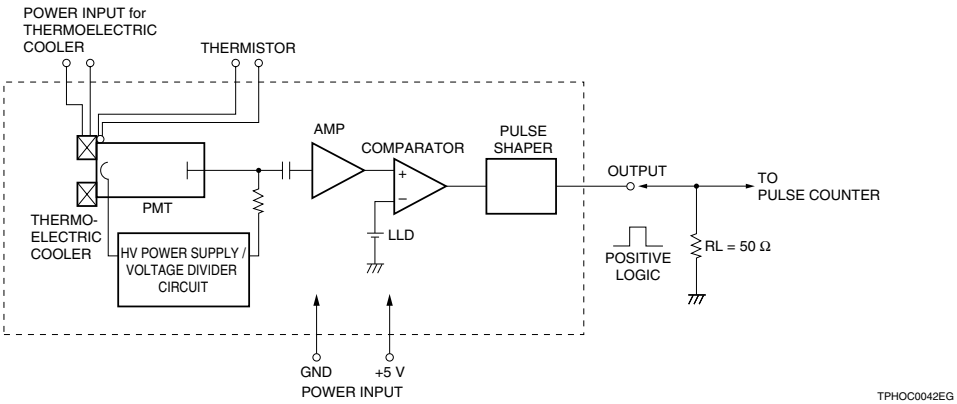
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Characteristics (Count sensitivity, Dark count)

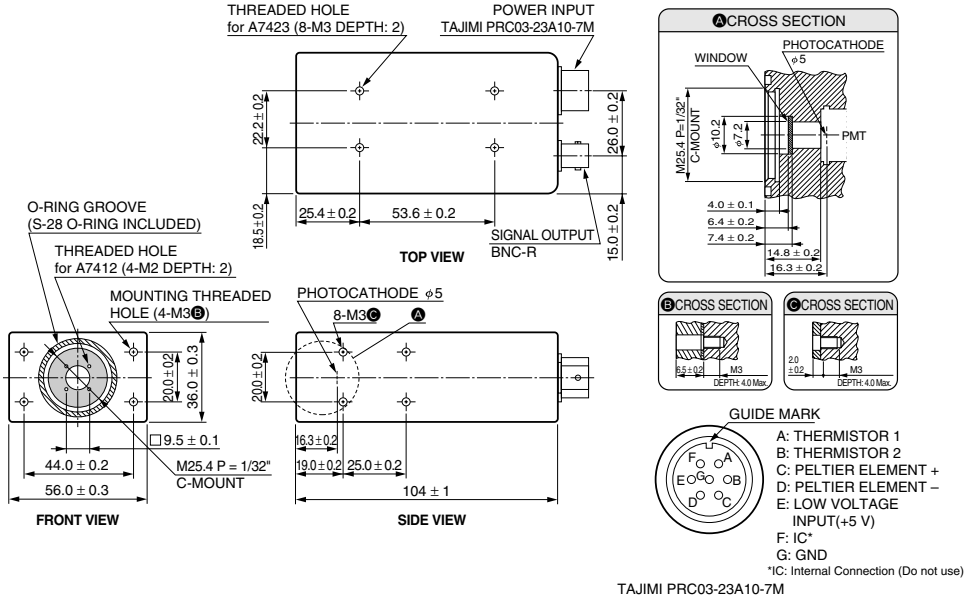




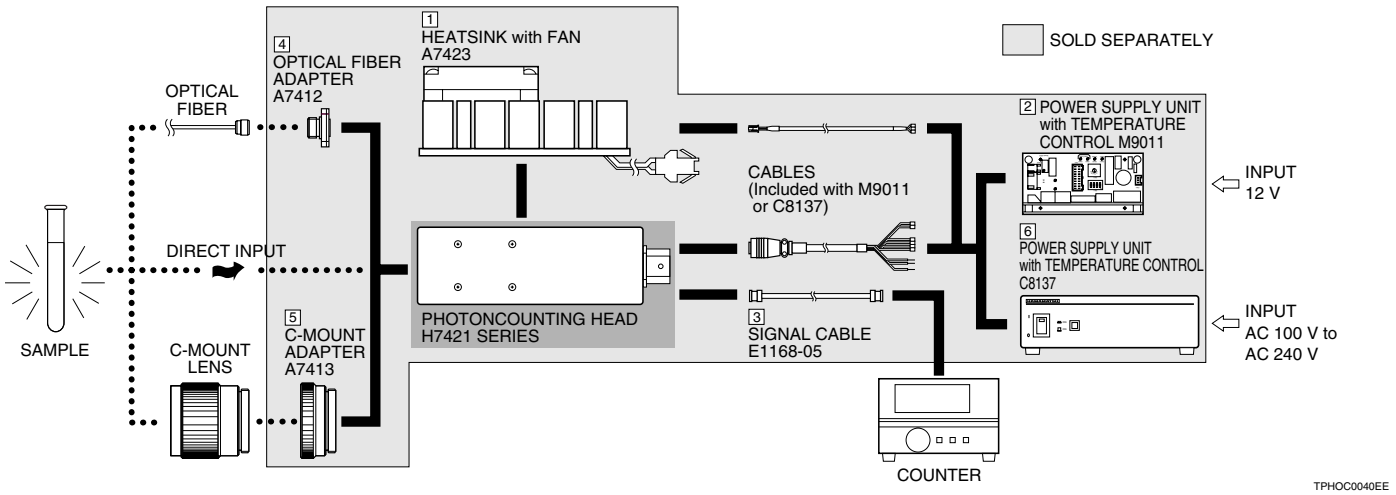
Block Diagram



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

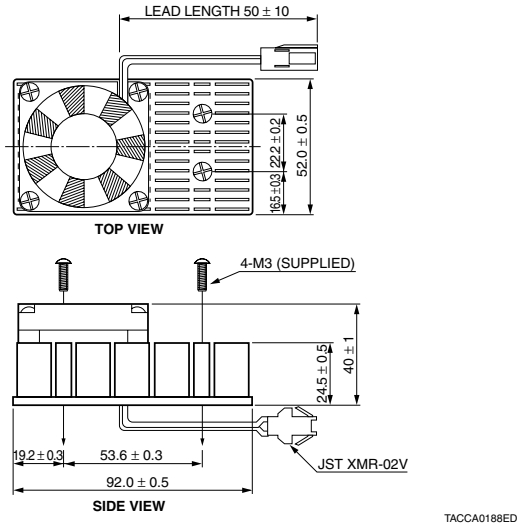
The C8137 is a power supply unit with a temperature control function. Just connecting to an AC source of 100 V to 240 V generates the output voltages for the thermoelectric cooler and the A7423 fan, needed for operating the H7421. The photomultiplier tube temperature can be maintained to 0 °C by monitoring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

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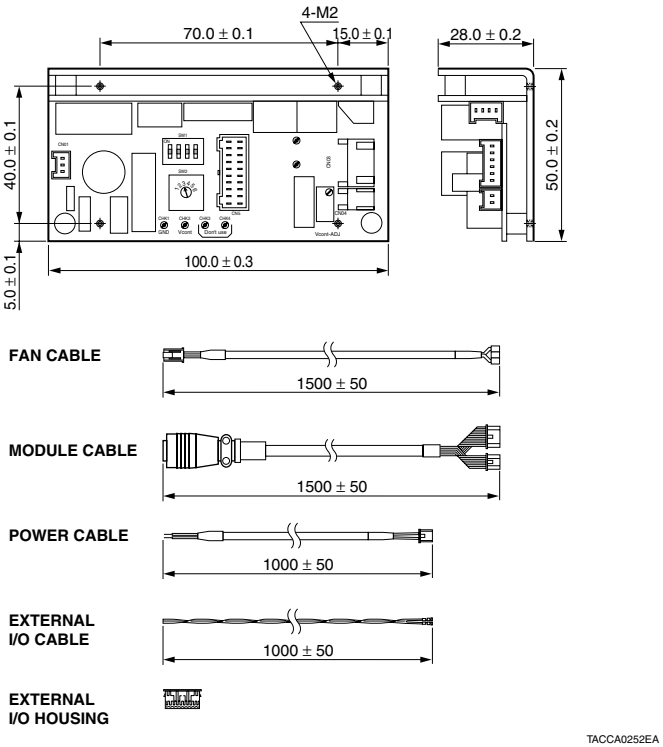
Options (Unit: mm)

1 Heatsink with Fan A7423



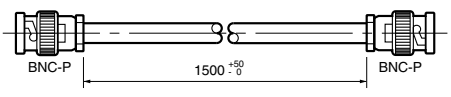
TACCA0188ED

2 Power Supply Unit with Temperature Control M9011



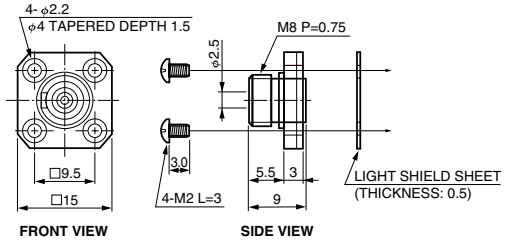
TACCA0252EA

3 Signal Cable E1168-05



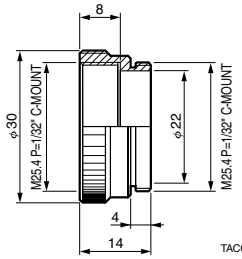
TACCA0148EA

4 Optical Fiber Adapter (FC Type) A7412



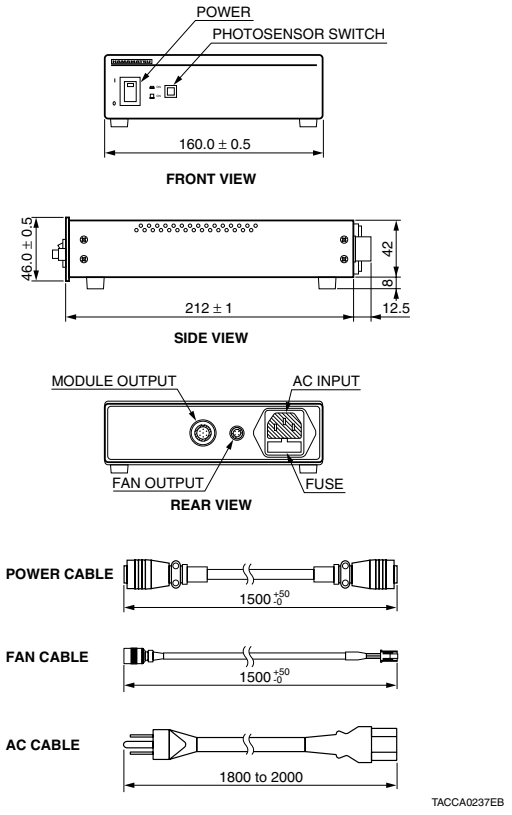
TACCA0190EB

5 C-mount Adapter A7413



TACCA0191EA

6 Power Supply Unit with Temperature Control C8137



TACCA0237EB

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Side-on PMT

Photon Counting Head H8259 Series



The H8259 series is a photon counting head device containing a 28-mm (1-1/8") diameter side-on photomultiplier tube, high-speed photon counting circuit, and a high-voltage power supply circuit. 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

This product can't be used at vacuum environment or reduced pressure environment. Please pay attention when the H8259 series is used for measuring the light below 190 nm.

Specifications

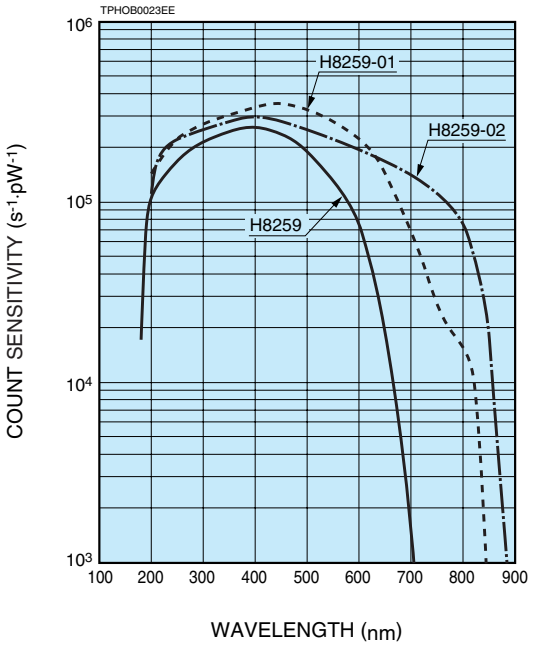
(at +25 °C)

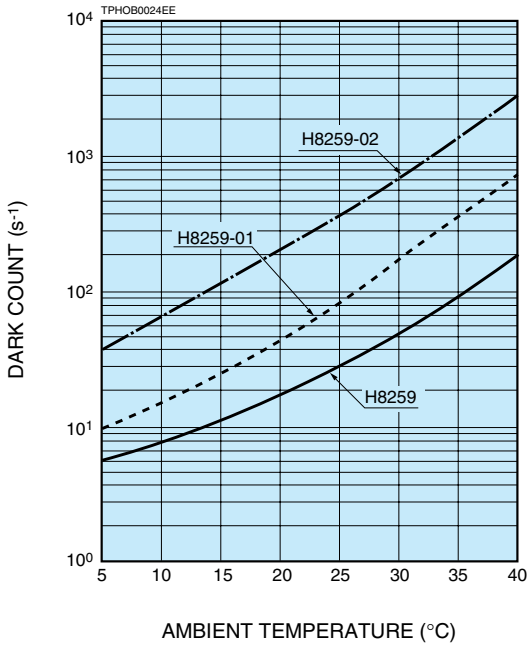
Parameter				H8259	H8259-01	H8259-02	Unit
Input Voltage				+4.5 to +5.5			V
Max. Input Voltage				+6			V
Max. Input Current				80			mA
Effective Area				4 × 20		4 × 6	mm
Peak Sensitivity Wavelength				400	430	400	nm
Count Sensitivity	Typ.	300 nm		2.1×10^5	2.7×10^5	2.5×10^5	$s^{-1} \cdot pW^{-1}$
		400 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

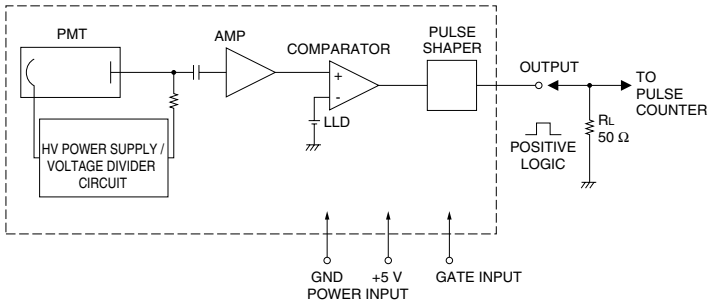
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Characteristics (Count sensitivity, Dark count)



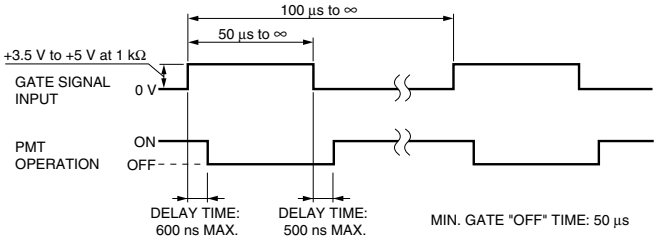


Block Diagram



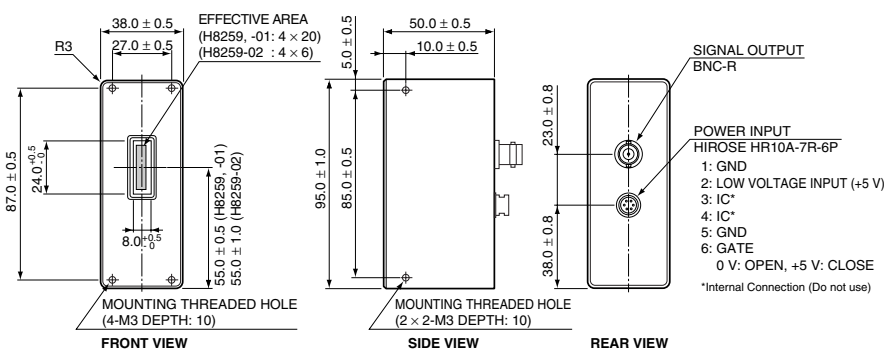
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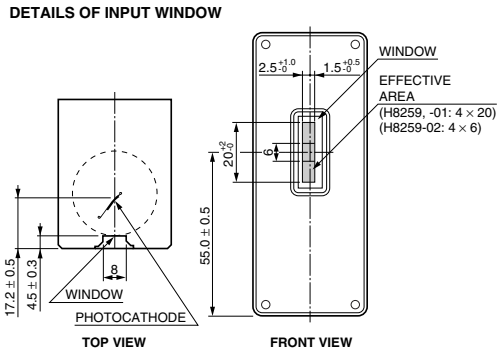
Gate Timing Chart



TPHOC0044EB

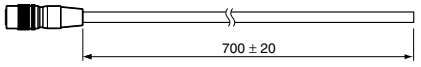
Dimensional Outlines (Unit: mm)





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

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Compact Head-on PMT

Photon Counting Head H7828 Series



The H7828 series is a photon counting head device containing a 19-mm (3/4") diameter head-on photomultiplier tube, a high-speed photon counting circuit, and a 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 has higher resistance to vibration and shock, making them suitable for portable or mobile measurement equipment.

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

This product can't be used at vacuum environment or reduced pressure environment.

Specifications

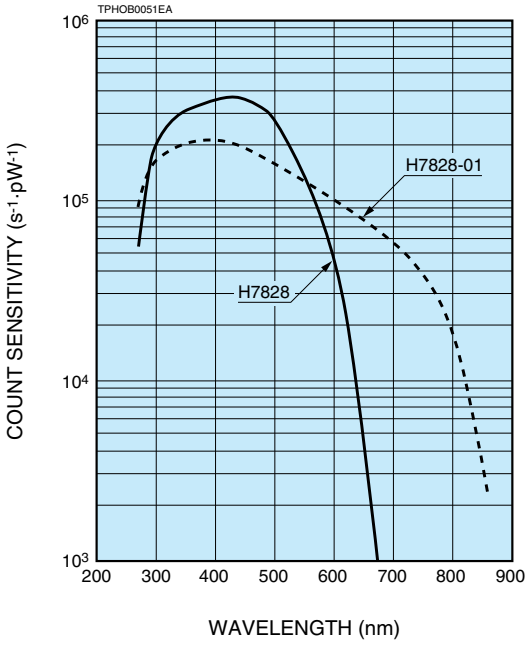
(at +25 °C)

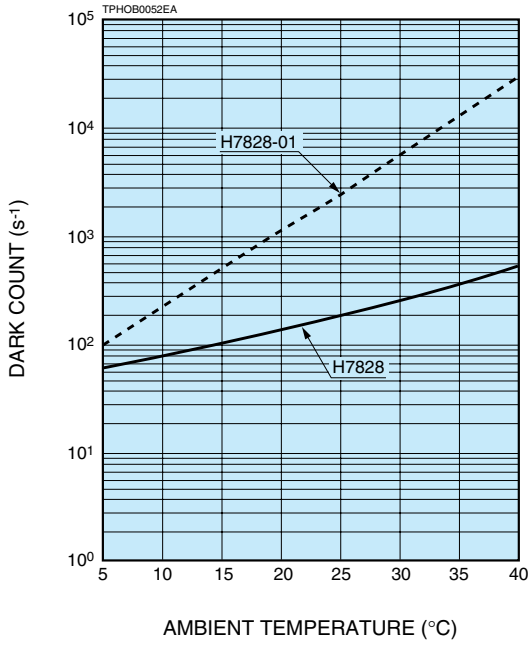
Parameter			H7828	H7828-01	Unit
Input Voltage			+4.5 to +5.5		V
Max. Input Voltage			+6		V
Max. Input Current			60		mA
Effective Area			ϕ15		mm
Peak Sensitivity Wavelength			420	380	nm
Count Sensitivity	Typ.	300 nm	2.1×10^5	1.7×10^5	$s^{-1} \cdot pW^{-1}$
		400 nm	3.6×10^5	2.1×10^5	
		500 nm	2.8×10^5	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

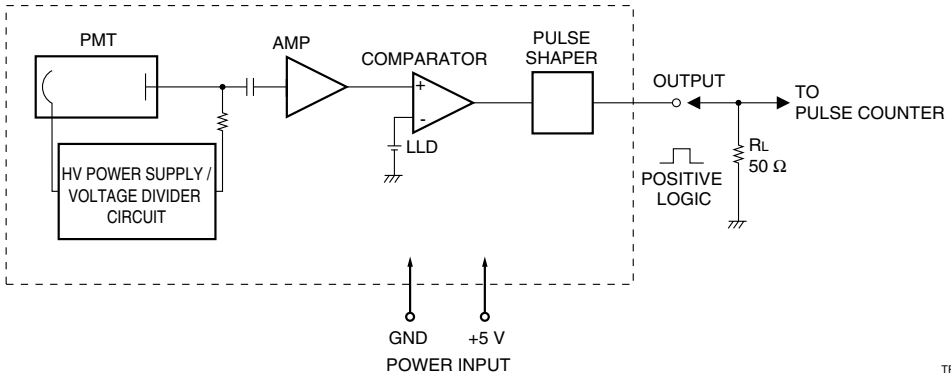
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Characteristics (Count sensitivity, Dark count)

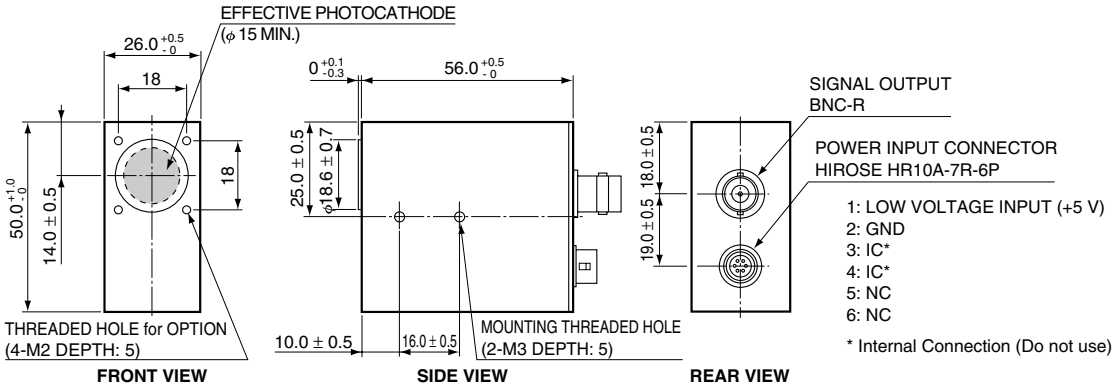




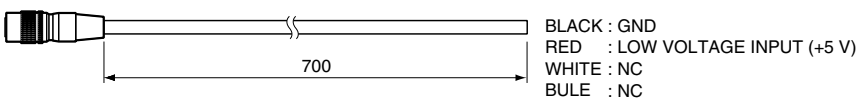
Block Diagram



Dimensional Outlines (Unit: mm)



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



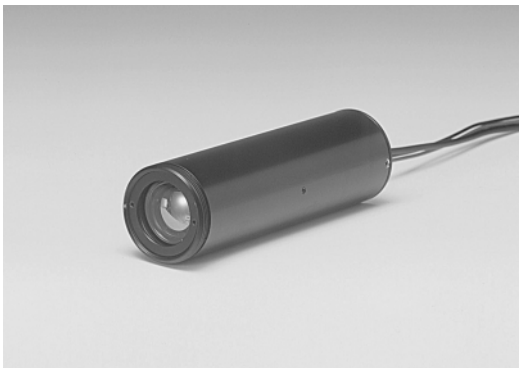
BLACK : GND
RED : LOW VOLTAGE INPUT (+5 V)
WHITE : NC
BULE : NC
GREEN: NC

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Head-on PMT

Photon Counting Head H7360 Series



The H7360 series is a wide sensitive area photon counting head device containing a 25-mm (1") diameter head-on photomultiplier tube, a high-voltage power supply circuit and a 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

This product can't be used at vacuum environment or reduced pressure environment.

Specifications

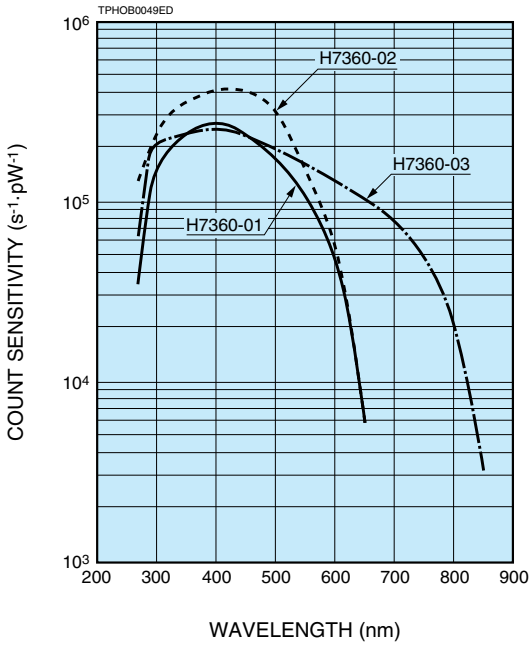
(at +25 °C)

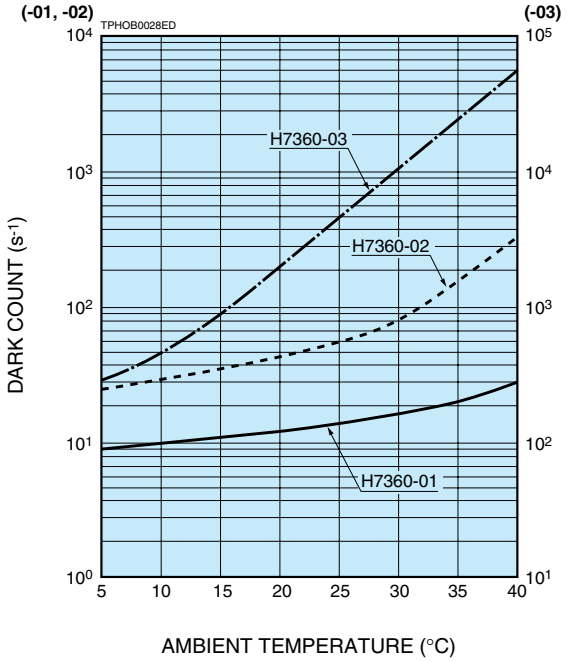
Parameter			H7360-01	H7360-02	H7360-03	Unit
Input Voltage			+4.75 to +5.25			V
Max. Input Voltage			+6			V
Max. Input Current			140			mA
Effective Area			ϕ22			mm
Peak Sensitivity Wavelength			375	420	420	nm
Count Sensitivity	Typ.	300 nm	1.4×10^5	2.3×10^5	2.1×10^5	$s^{-1} \cdot pW^{-1}$
		400 nm	2.7×10^5	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

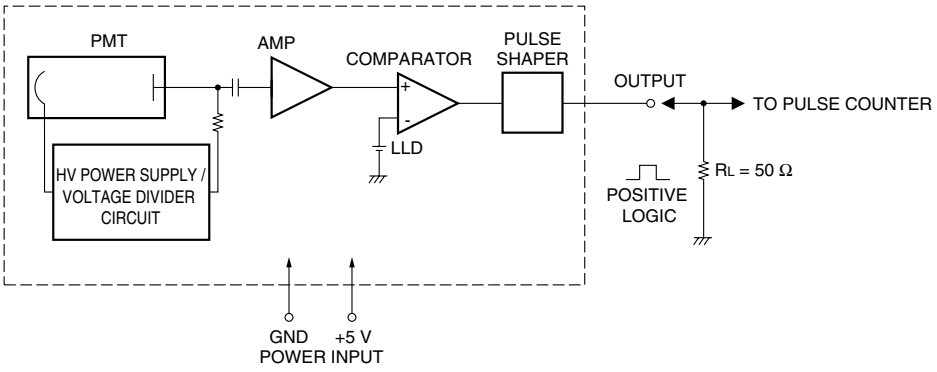
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Characteristics (Count sensitivity, Dark count)

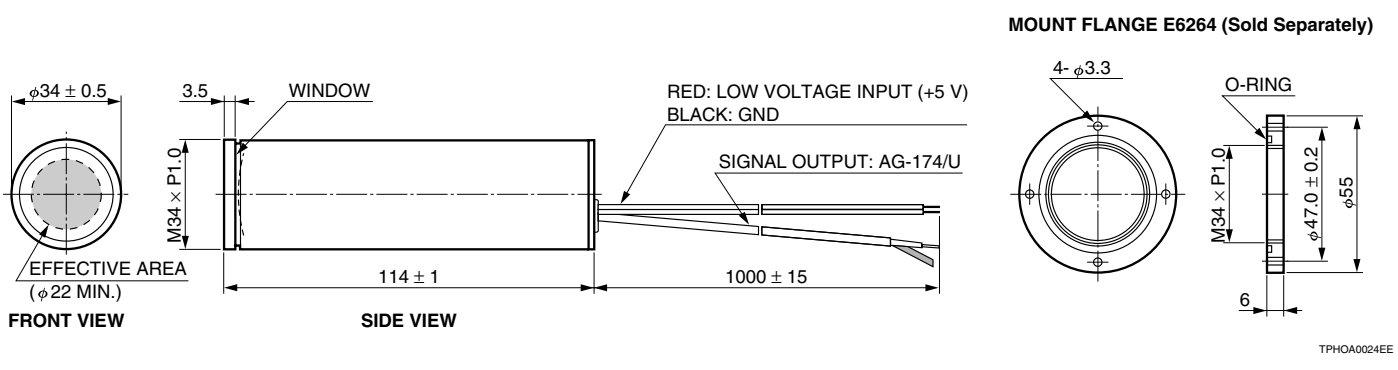




Block Diagram



Dimensional Outlines (Unit: mm)



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Metal Package PMT

Photon Counting Head H11123



The H11123 is a photon counting head device consisting of a 28-mm (1-1/8") diameter head-on photomultiplier tube, a high-speed photon counting circuit, and a high-voltage power supply circuit. The high voltage power supply for photomultiplier tube and the discrimination level are preset to optimum values, allowing photon counting measurement by just connecting a +5 V supply. The H11123 can operate at high count rate.
The effective photosensitive area is as large as 25 mm in diameter, so the incident light can be collected very efficiently.

Product Variations

Type No.	Spectral Response	Features
H11123	300 nm to 650 nm	High detection efficiency

This product can't be used at vacuum environment or reduced pressure environment.

Specifications

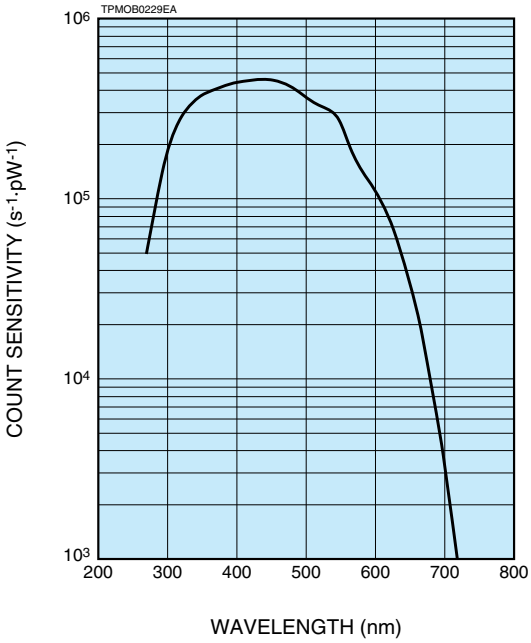
(at +25 °C)

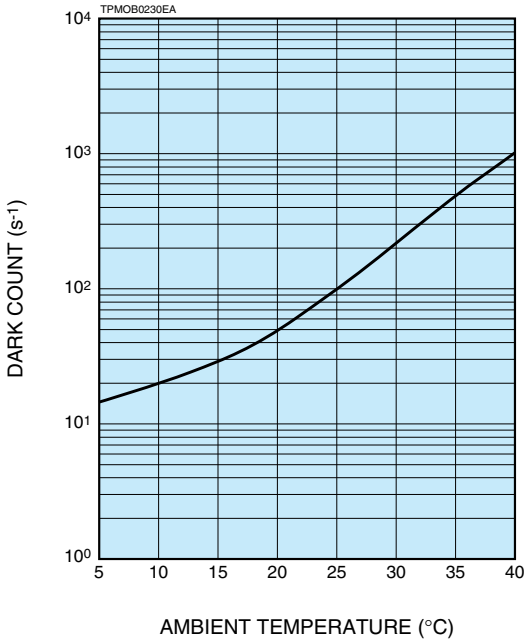
Parameter			Value	Unit
Input Voltage			+4.75 to +5.25	V
Max. Input Voltage			+6	V
Max. Input Current			70	mA
Effective Area			ϕ25	mm
Peak Sensitivity Wavelength			420	nm
Count Sensitivity	Typ.	300 nm	1.9×10^5	$s^{-1} \cdot pw^{-1}$
		400 nm	4.4×10^5	
		500 nm	3.6×10^5	
		600 nm	1.1×10^5	
Count Linearity *1			5.0×10^6	s^{-1}
Dark Count *2		Typ.	100	s^{-1}
		Max.	200	
Pulse-Pair Resolution		Typ.	20	ns
Output Pulse Width		Typ.	10	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			+5 to +40	°C
Storage Temperature *4			-20 to +50	°C
Weight			260	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
*4: No condensation

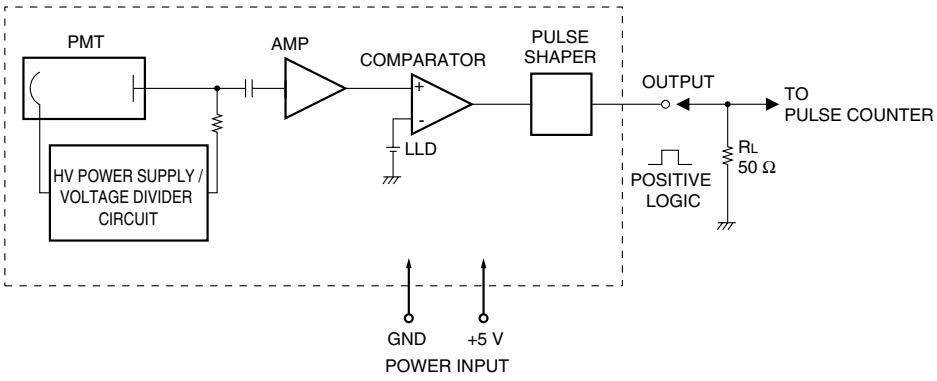
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Characteristic (Count sensitivity)



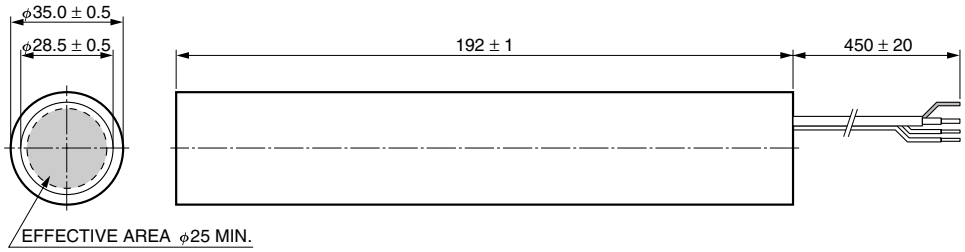


Block Diagram



TPMOC0223EA

Dimensional Outlines (Unit: mm)



LOW VOLTAGE INPUT (+5 V): AWG26 (RED)
GND : AWG26 (BLACK)
SIGNAL OUTPUT : RG-174/U

TPMOA0065EA

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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, a photon counting circuit, a high-voltage power supply circuit, counter and a 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 20×10^6 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

This product can't be used at vacuum environment or reduced pressure environment.

Specifications

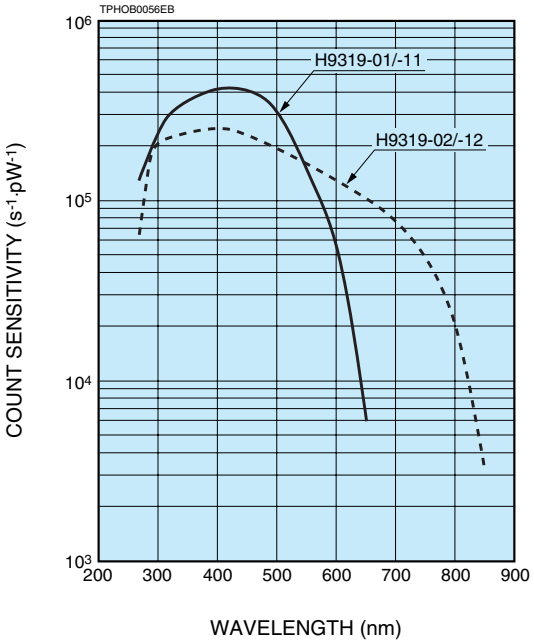
(at +25 °C)

Parameter			H9319-01	H9319-11	H9319-02	H9319-12	Unit
Input Voltage			+4.75 to +5.25				V
Max. Input Voltage			+6				V
Max. Input Current			60				mA
Effective Area			ϕ 22				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			20×10^6				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

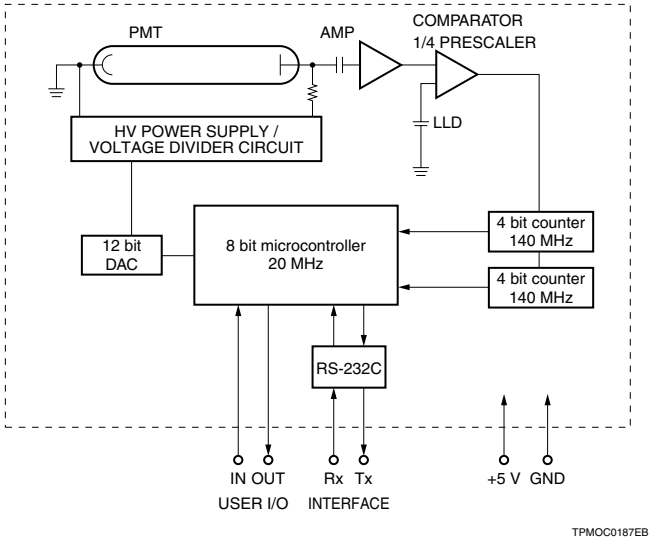
*1: Random pulse, within ±1 % count loss (by count linearity compensation)
*2: After 30 minutes storage in darkness
*3: The time required for the output to reach a stable level following a change in the control voltage from 500 V to 1000 V in darkness
*4: The time required for the output to reach a stable 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

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Characteristic (Count sensitivity)



Block Diagram

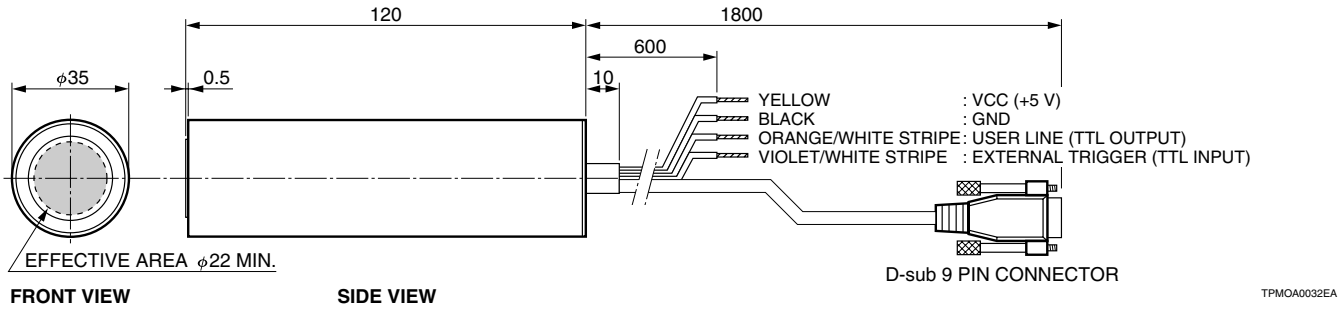


Command List

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)



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Related Products

Power Supplies for PMT Modules C7169, C10709

The C7169 and C10709 are power supply units for driving photomultiplier tube modules. Both drive voltages and control voltages can be supplied from this one unit.

Applicable products:

C7169 : H9305/H9306/H9307 Series, H7826/H7827 Series
H10425/H10426 Series, H10492/H10493 Series, H11526 Series

C10709: H10720/H10721/H10722/H10723 Series, H11461/H11462 Series

* Please contact us for information on PMT modules not listed in this catalog.



Parameter		C7169	C10709	Unit
Output Voltage		±15	±5	V
Output Current	Max.	0.3 (+15 V), 0.2 (-15 V)	2.0 (+5 V), 0.2 (-5 V)	A
Control Voltage (variable voltage range) *1		+0.25 to +1.8		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.

C9999 : Wide bandwidth from DC to 10 MHz and gain of 43 dB.

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.

C11184: Wide bandwidth from DC to 300 MHz and gain of 28 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 (C9999), C7319, C6438, C5594

Parameter		C7319	C9999	C6438	C6438-01	C9663	C11184	C5594-44	Unit
Frequency Bandwidth (-3 dB)		DC to 20 kHz or DC to 200 kHz (switchable)*1	DC to 10 MHz	DC to 50 MHz	DC to 50 MHz	DC to 150 MHz	DC to 300 MHz	50 kHz to 1.5 GHz	—
Voltage Gain		— *2	43 ± 3 *4 (Approx. 139 times)	20 ± 3 *4 (Approx. 10 times)	54 ± 3 *4 (Approx. 500 times)	38 *4 (Approx. 80 times)	28 ± 2 *4 (Approx. 25 times)	36 *4 (Approx. 63 times)	dB
Current-to-Voltage Conversion Factor		0.1 V/µA, 1 V/µA or 10 V/µA (switchable)	50 mV/µA *5	0.5 mV/µA *5	25 mV/µA *5	4 mV/µA *5	1.25 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)	±Voltage (non-inverted)	±Voltage (non-inverted)	—
Input Impedance		— *2	360	50	50	50	50	50	Ω
Recommended Load Resistance		—	50	50	50	50	50	50	Ω
Output Signal Voltage	Max.	±13 *3	±1.3 *4	±1 *4	±1 *4	±1.4 *4	±1 *4	+0.8, -2.5 *4	V
Connector	Input	BNC-R	BNC-R	BNC-R	BNC-R	BNC-R	MCX-R *6	BNC-R	—
	Output	BNC-R	BNC-R	BNC-R	BNC-R	BNC-R	MCX-R *6	BNC-R	—
	Power	DIN (6-pin)	DIN (6-pin)	DIN (6-pin)	DIN (6-pin)	DIN (6-pin)	—	—	—
Input Voltage		±5 to ±15	±5	±5	±5	±5	±5	+12 to +16	V
Input Current	Max.	±50	±70	±55	±80	±80	±70	+95	mA
Dimensions (W × H × D)		60 × 43.2 × 65	60 × 43.2 × 65	60 × 43.2 × 65	60 × 43.2 × 65	60 × 43.2 × 65	52 × 14.5 × 28	54 × 17 × 33	mm
Weight		Approx.170	Approx.180	Approx.160	Approx.160	Approx.180	Approx.40	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: MCX-BNC adapter supplied

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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. (See P.11)
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.

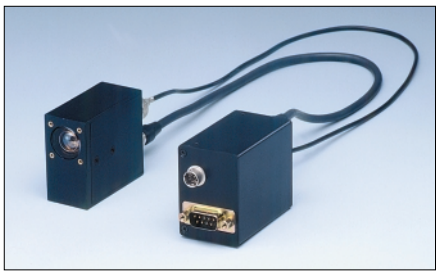


Parameter		Description / Value		Unit
Input Impedance		50		Ω
Discrimination Level (input conversion)		-0.4 to -16		mV
Required PMT Gain		3×10^6		—
Prescaler		÷1	÷10	—
Count Linearity	÷1	4×10^6		s^{-1}
	÷10	1×10^7		
Pulse-pair Resolution	÷1	25		ns
	÷10	10		
Output Pulse		CMOS 5 V, POSITIVE LOGIC		—
Output 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 *1, H9305 *1 *2, H10425 *1 *2, H10426 *1 *2 *3	—

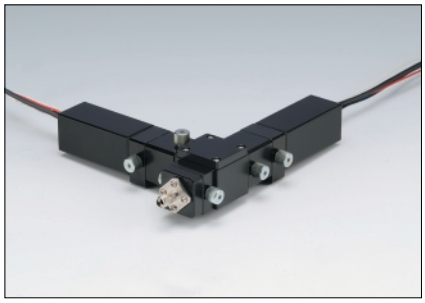
*1: The cables for applicable modules can be supplied with a voltage input connector (HIROSE HR10A-7P-6P) attached to the cable end (at an additional charge). Please specify when ordering.
*2: The cables for applicable modules can be supplied with a signal connector (BNC-P) attached to the cable end (at an additional charge). Please specify when ordering.
*3: Control voltage of up to +1.2 V can be used.

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Related Products

Optical Blocks for PMT Modules

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



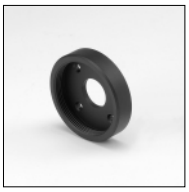
▲Optical block combinations

LINEUP



Adapter Block A10030-01

The A10030-01 is an adapter block for connecting a PMT module to a V-groove type optical block.



C-Mount Ring A9865

This ring connects a PMT module to C-mount threaded optical blocks. This ring can also be connected to a device with C-mount.



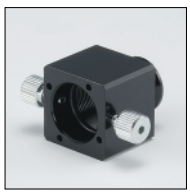
Fiber Adapter Block A100037 Series

This block connects to optical fibers with a FC/SMA connector. The lens assembled in the block collimates the light spreading from the optical fiber.



C-Mount Adapter Block A10039

This block connects a device having C-mount to V-groove type optical blocks. The connection angle for the device and block is adjustable.



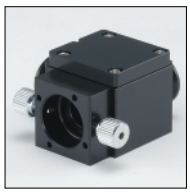
Filter Block A10033 Series

This block contains a filter that allows particular wavelengths to pass through it. A total of 10 products are available with either a bandpass filter or a long-pass filter.



C-Mount Interchangeable Filter Block A11213 Series

The A11213 series is a C-mount connection block for installing a commercially available 25 mm diameter filter or lens. This block allows angle adjustment and so is useful as a spacer or adapter that connects between C-mounts.



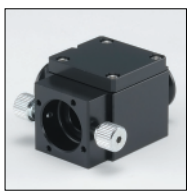
Dichroic Block A10034 Series

This block contains a dichroic mirror that reflects particular wavelengths but passes other wavelengths. A total of six products are available.



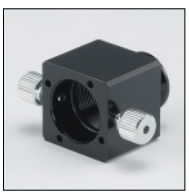
C-Mount Interchangeable Block for Dichroic Mirror A11214

The A11214 is a C-mount connection block for installing a commercially available dichroic mirror having a 45 degree incident angle, 1 mm thickness, and dimensions of 26 × 38 mm.



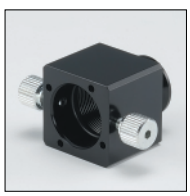
Beam Splitter Block A10035

This block contains a cubic type half-mirror. Incident light is split into a reflected beam (R) and transmitted beam (T) at a ratio of 1 to 1. A holder block designed to assemble a commercially available beam splitter is also provided.



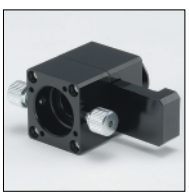
ND Filter Block A10032 Series

This block contains a neutral density (ND) filter to attenuate light levels. Two types are available with a transmittance of 1 % or 10 %.



Interchangeable Filter block A10033-90

The A10033-90 is a holder block for assembling a commercially available 15 mm diameter filter. Use this holder block in cases where the desired filter is not provided with the A10032/A10033 series.



Shutter Block A10036

The A10036 is a manual shutter block with a plate that opens and closes by sliding it left and right. Light is fully blocked so no problems occur even at photon counting levels.

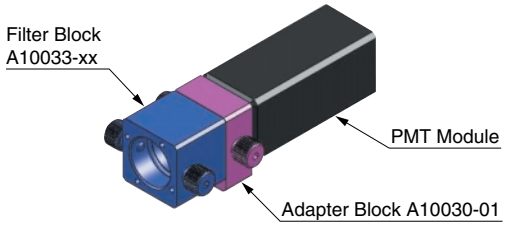
* Other types of optical blocks are also available besides the products listed here.
For more details please refer to the individual catalogs or access our web site.

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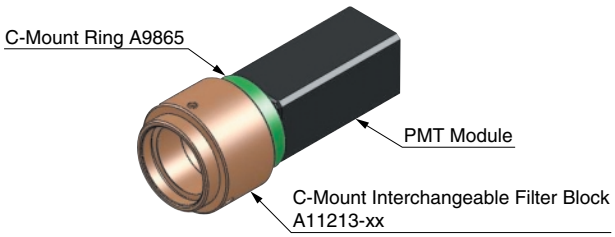
■CONNECTION EXAMPLES

●Single Wavelength Detection

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

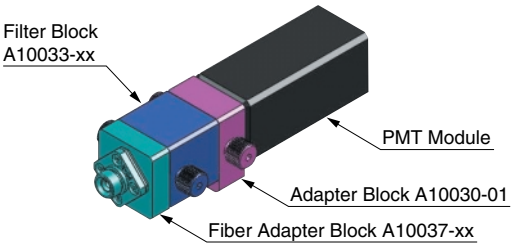


◆ When using commercially available optical filter

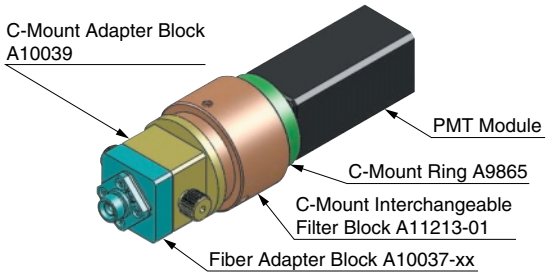


●Fiber-Optic Single Wavelength Detection

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

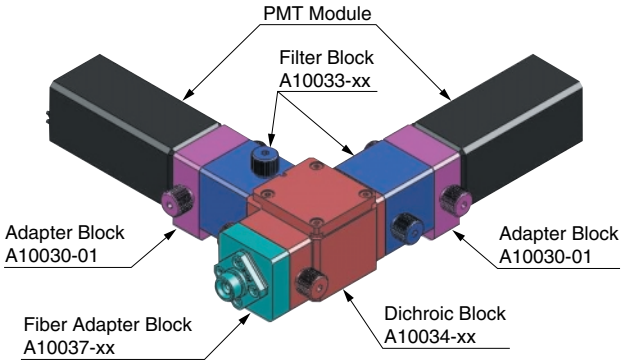


◆ When using commercially available optical filter

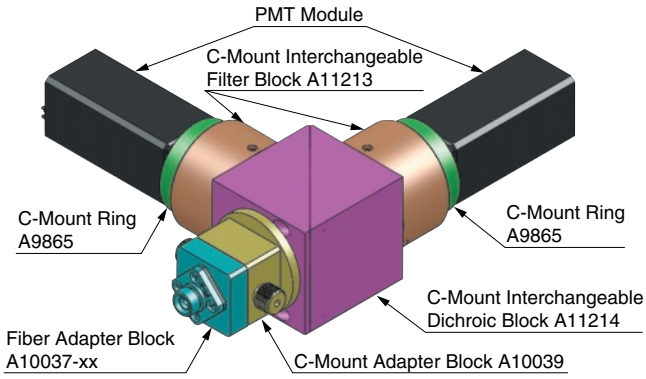


●Fiber-Optic Dual Wavelength Detection

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



◆ When using commercially available optical filter



■COMPATIBLE PMT MODULES

Compatible PMT Modules	Optical Blocks Connected to PMT Modules
H10720 / H10721 / H10722 / H10723 / H10682 / H11526 H10799 (built-in Photodiode)	A10030-01 A9865
H7421 / H7422	A10039 A11213 Series
H8259 / H11461 / H11462 * In preparation for use with optical blocks, a C-mount adapter plate must be attached to the PMT module. Please notify us of your need for this adapter when ordering.	A10039 A11213 Series

*For details about PMT modules, see the "Photomultiplier Tube Modules" catalog.

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Counting Unit C8855-01

The C8855-01 is a counting unit with a USB interface and can be used as a photon counter when combined with a photon counting head, etc. (See P.11)
The counter of the C8855-01 includes two counter circuits (double counter method) capable of counting input signals with no dead time. The USB interface easily connects to a laptop PC allowing measurement in an even wider application field. When used with a photon counting head, the C8855-01 supplies power (+5 V / 200 mA) necessary to operate the photon counting head.
Since the C8855-01 is hot-swap compatible (plug and play compatible), it helps you set up measurement environment quickly. You can start measurement on the day the C8855-01 is delivered by using the sample software that supplied with the C8855-01.



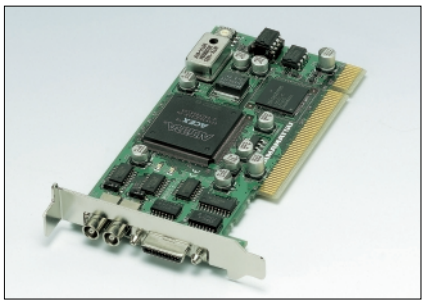
- **Time-resolved measurement (minimum resolution: 50 μs) for monitoring chemiluminescence and biological clocks**
- **Quick measurement setups (hot-swap compatible)**
  When software such as a device driver is installed into your PC beforehand, you can start measurement by just connecting the USB cable, without restarting the PC.
- **Applicable to various measurement methods**
  The C8855-01 is fully controlled by DLL (dynamic link library) functions that come with the C8855-01.
  All information on these DLL functions is available to support software programming that handles various types of user measurement applications.
- **Since the C8855-01 has an ID switch, a maximum of 16 units can be connected to one PC and controlled individually.**

Parameter		Description / Value
Input	Number of Input Signals	1 ch
	Signal Input Level	CMOS positive logic (high level: 2 V min.)
	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 *1	50 μs to 10 s (1, 2, 5 step)
Trigger	Trigger Method	External trigger / Software trigger
	External Trigger Signal	TTL negative logic
ID Switch *2		0 to F(hexadecimal number) Select
General Output Section		Open collector / 2 bits
Voltage Output		+5 V / 200 mA Max.
Compatible OS		Windows® 2000 / XP Pro / Vista Business (32 bit) / 7 Pro (32 bit)
Interface		USB
Supply Voltage		+7 V / 500 mA Max. (supplied from AC adapter)
Dimensions (W × H × D)		120 mm × 30 mm × 96 mm (excluding rubber feet and projecting parts)
Weight		250 g
Operating Ambient Temperature / Humidity *3		+5 °C to +45 °C / Below 80 %
Storage Temperature / Humidity *3		0 °C to +50 °C / Below 85 %
CE Marking		Conforms to the IEC 61236-01 GROUP 1, CLASS B
AC Adapter	AC Input	100 V to 240 V
	Output	7 V / 1.6 A

*1: The C8855-01 is not suitable for applications requiring time resolution higher than 50 μs. In such applications, use a counting board M9003-01.
*2: The ID switch is used to set ID numbers when two or more C8855-01 units are connected to single PC.
*3: 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.
** : The above specifications are guaranteed when one C8855-01 is connected to one PC. Controlling multiple units from one PC depends on the performance of the PC.

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Counting Board M9003-01



The M9003-01 counting board is a PCI bus add-in board counter that functions as a photon counter when used along with a photon counting head. (See P.11)
The counter section of the M9003-01 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 M9003-01 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 M9003-01 is PnP (plug and play) compatible. You can start making measurements right away after the M9003-01 is unpacked, by just using the sample software that comes supplied with the M9003-01.

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 *2 / Reciprocal mode *3
	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 12.8 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 (3 bits)
	Input Strobe Signal	TTL level signal
	Output Signal	Open collector (4 bits)
	Output Strobe Signal	Open collector
Compatible OS		Windows® 2000 / XP Pro / Vista Business (32 bit) / 7 Pro (32 bit)
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 (low profile)
Weight		80 g
Operating Ambient Temperature / Humidity *1		+5 °C to +40 °C / Below 80 %
Storage Temperature / Humidity *1		0 °C to +50 °C / Below 85 %
CE Marking		Conforms to EMC directives (89 / 336 / EEC) of the European Union

*1: No condensation
*2: Gate counter mode counts the input signal pulses only during each specified gate time.
*3: Reciprocal counter mode counts the number of internal clock pulses generated between input signal pulses.
Supplied: CD-ROM (containing instruction manual, device drivers, sample software*, etc.),
Signal cable E1168-22 × 2 (LEMO-BNC: coaxial 1.5 m),
General-purpose I/O cable with connector.
* Sample software is configured from Lab VIEW™ of National Instruments, Inc.

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General Characteristics

Photocathode radiant sensitivity and quantum efficiency

Radiant sensitivity is the photoelectric current generated from the photocathode when struck by light at a given wavelength, divided by the incident radiant power, and expressed in A/W (amperes per watt). Quantum efficiency (QE) is the number of photoelectrons emitted from the photocathode divided by the number of incident photons and is usually expressed as a percent. Cathode radiant sensitivity is one factor in determining signal-to-noise (S/N) characteristics and detection limit of measurement systems, and is used to calculate signal-to-noise ratio (S/N ratio) and noise equivalent power (NEP) representing a lower detection limit.
Measurement of radiant sensitivity requires a sophisticated system using a spectrophotometer and also takes a lot of time. Because of this, we only attach spectral response data showing radiant sensitivity to the photomultiplier tube when specially requested by the customer and we charge for this service. Cathode radiant sensitivity cannot be measured once the photomultiplier tube is assembled as a module. If radiant sensitivity data is necessary, please request it when placing an order.

Luminous sensitivity

Cathode luminous sensitivity is the photoelectric current generated from the photocathode when a photomultiplier tube receives light flux from a tungsten filament lamp operated at a distribution temperature of 2856 K. Anode luminous sensitivity is the anode output current per incident light flux on the photocathode of a photomultiplier tube when a specific high voltage is applied. The light flux is lowered to an appropriate level by using a neutral density filter.
Luminous sensitivity data is measured and listed in the test sheet prior to shipment except for some types of PMT modules. Luminous sensitivity is particularly useful when comparing PMT modules having a similar spectral response range.

Blue sensitivity index and red/white ratio

Although different from absolute spectral response characteristics, the blue sensitivity index and the red/white ratio are often used for simple comparison of photomultiplier tube spectral response.
Blue sensitivity index is the photoelectric current generated from the photocathode when a blue filter is interposed in the same measurement system as used to measure cathode luminous sensitivity. Blue sensitivity index is an essential parameter in scintillation counting because the NaI(Tl) scintillators frequently used in scintillation counting, produce light emissions close to the blue spectrum when transmitted through a blue filter. Blue sensitivity index is not represented in lumens because the light flux once transmitted through a blue filter cannot be expressed in lumens.
Red/white ratio is used for comparing the sensitivity of photomultiplier tubes having a spectral response extending to the near infrared region. Like blue sensitivity index, the red/white ratio is also measured with the measurement system used for cathode luminous sensitivity, but a red to infrared filter is interposed. Red/white ratio is defined as the ratio of the cathode sensitivity measured with a red to infrared filter, to the cathode luminous sensitivity when measured without a filter.

Gain

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

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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.

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Photosensor Module with Gate Function

Gate operation

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

Gate noise

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

Switching ratio

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

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

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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.

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