

PHOTONIC DEVICES 2021

Electron Tube Devices and Applied Products





Photonic Devices 2021 Electron Tube Devices and Applied Products

Electron tube devices, developed by harnessing technologies accumulated over long periods of time and involved in cutting-edge scientific research, are key devices for measuring the unobservable and capturing the undetectable. Our electron tube devices are still evolving, via the use of new technologies, into more compact, lightweight, sophisticated and versatile products optimized for specific uses and environments, and their evolution expands the application fields of the equipment where they are installed.

Hamamatsu Photonics provides a wide range of electron tube devices that play active roles in a diverse array of fields including medical care, spectroscopy and analysis, semiconductor industry, biotechnology, and academic and scientific research. This brochure introduces innovative electron tube devices that we have newly designed and manufactured to push their performance even further.

	■ Laser Microscopy	4
	● Photosensor Modules (GaAsP Photocathode) H16200-40, H16201-40	
	● Photosensor Module (GaAsP Photocathode) H12056-40	
	● Photosensor Module (GaAsP Photocathode) H15460-40	
	● Photosensor Module (InP/InGaAsP Photocathode) H15620-25/-45	
	■ Flow Cytometry	6
	● Photosensor Modules (InGaAs Photocathode)	
	● Linear Multianode Photomultiplier Tube Module H15441-20	
	● Flow Cells - AR (Antireflection) Coating	
	■ In Vitro Diagnostics	8
	● Micro PMT Module H15691-008	
	● Photon Counting Head H14870	
	● Immunochromato-Reader C10066-60	
N	■ Mass Spectrometry (MS)	10
	● Dual Mode Ion Detector R15244	
	● Ceramic Channel Electron Multiplier CERARION® R14747-80	
	● Ionization-Assisting Substrates DIUTHAME®	
	■ Underwater Optical Communication	12
	● Photosensor Modules H14447, H14990-100-02, H14600-100, H14601-100	
	■ High Energy Physics Research	13
	● Photomultiplier Tube R14688-100	
	● Photomultiplier Tube R15608	
D	■ Printing	14
	● Low Energy Electron Beam Source EB-ENGINE™ - Long Type	
	● Linear Irradiation Type UV-LED Unit LIGHTNINGCURE® LC-L5G GH-103A	
	● Linear Irradiation Type UV-LED Unit LIGHTNINGCURE® LC-L5G GC-113A	
	● UV-LED Spot Light Source LIGHTNINGCURE® LC-L1V5	
	■ Bonding	16
	● Linear Irradiation Type UV-LED Unit LIGHTNINGCURE® LC-L5G GA-108	
	● UV-LED Spot Light Source LIGHTNINGCURE® LC-L1V5	
	■ Electrostatic Charge Removal	17
	● Electrostatic Charge Removers VUV Ionizer L12542, L15094	
	■ X-ray Non-destructive Inspection	18
	● Soft X-ray Source L11754-01W	
	● Compact X-ray CMOS Camera DX-CUBE™ H8953-30	
	● 180 kV Microfocus X-ray Source L14351-02	
E	■ Micro PMT	20
	● Surface-Mount Package Micro PMT R12900U Series	
	● Micro PMT Modules H14066 Series	
	● Surface-Mount Package Micro PMT R15320U Series	
	● Multi-Wavelength Detection Unit	
	■ Infrared (IR) Light Sources	22
	● IR Graphene Light Source L15969	
	● Xenon Flash Lamp	
X	■ Imaging Devices	23
	● High-Speed Gated Image Intensifier Units C14245 Series	
	● High-Speed Gated Image Intensifier Units C16031 Series	

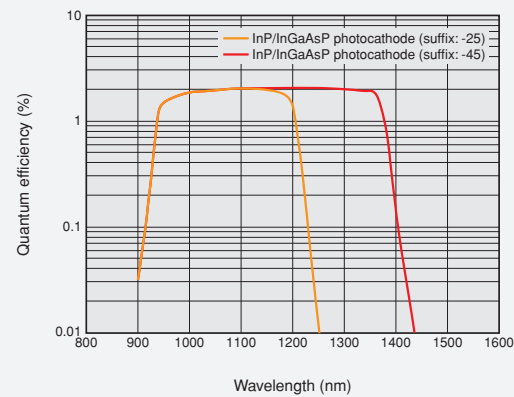
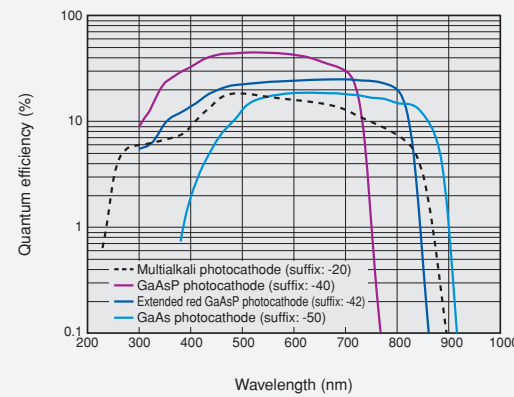
Laser Microscopy



In confocal laser microscopes and multiphoton excitation microscopes for laser microscopy, our photosensor modules that incorporate a photomultiplier tube or HPD (hybrid photo-detector) are becoming more and more widely used as detectors for capturing fluorescence and scattered light from the sample.

To keep up with increasing demands for single-molecule fluorescence imaging, we are continuing to improve our compound-semiconductor photocathode technology to further boost photomultiplier tube sensitivity. Besides developing GaAsP photocathodes useful for measurement in the visible light region such as for GFP (green fluorescence protein), we are also developing photomultiplier tubes with an extended red GaAsP photocathode, GaAs photocathode, and InP/InGaAsP photocathode that have high sensitivity in longer wavelength regions.

Spectral response (Typ.)



Gate Function for Optogenetics



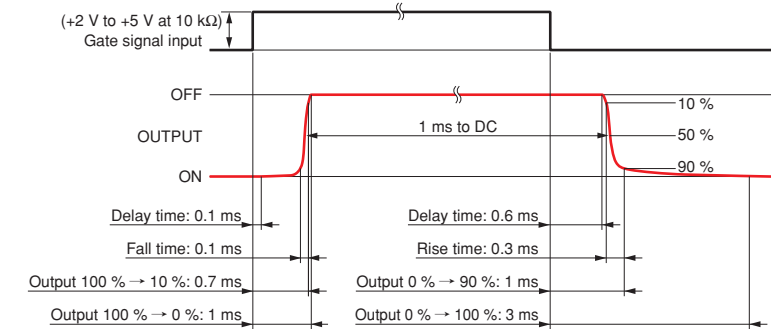
Photosensor Module (GaAsP Photocathode) H12056-40

NEW

Miniature size photomultiplier tube module with gate function from 1 ms to DC

The H12056-40 is a photosensor module using a GaAsP photocathode photomultiplier tube. It includes a gate function of 1 ms to DC, which is ideal for laser microscopes and protects the photomultiplier tube electronically from excessive light such as fluctuating background light that might enter the unit when changing the sample.

Gate timing chart (Typ.)



10x Larger Area for Multiphoton Excitation Microscopy

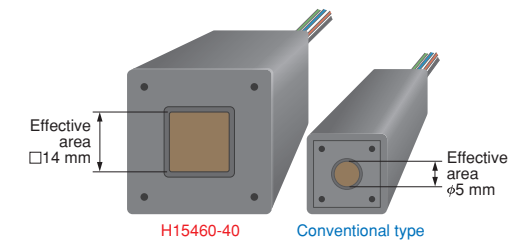


Photosensor Module (GaAsP Photocathode) H15460-40

NEW

Photomultiplier tube module with a large effective area and built-in high-frequency band amplifier

The H15460-40 photosensor module employs a GaAsP photocathode photomultiplier tube. The effective area is 14 mm square making it ideal for multiphoton excitation microscopes. The H15460-40 also includes an amplifier with a frequency band of 30 MHz and a current-to-voltage conversion factor of 0.02 V/ μ A.



For Better Image Contrast Without Protection Circuit

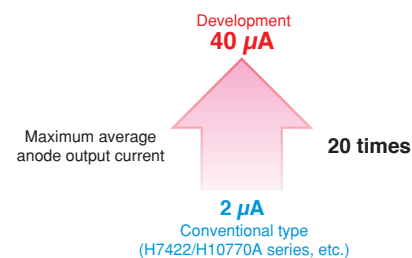


Photosensor Modules (GaAsP Photocathode) H16200-40, H16201-40

NEW

Easy-to-use photomultiplier tube modules with a wide dynamic range

These photosensor modules use a GaAsP photocathode photomultiplier tube. These achieve a wide dynamic range with a maximum output current of 40 μ A, providing clear images with sharp contrast and also ensuring stable operation without needing a protection circuit.



For NIR Detection

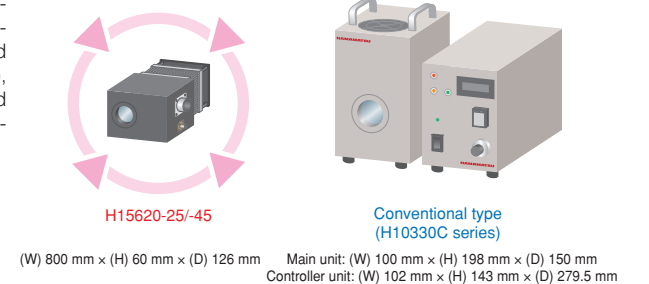


Photosensor Modules (InP/InGaAsP Photocathode) H15620-25/-45

NEW

Compact, easy-to-install photomultiplier tube modules

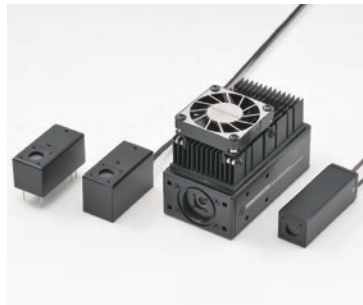
The H15620-25 and H15620-45 photosensor modules employ an InP/InGaAsP photocathode photomultiplier tube. Compared to the conventional type (H10330C series), these photosensor modules are designed to be compact making them easier to install in laser microscopes.



Flow Cytometry



A flow cytometer is an analytical instrument extremely useful in biological applications such as cell cycle analysis, cell analysis by cell surface antigen and cell sorting. Recently, flow cytometers are using multicolor fluorescent dyes and becoming more compact and lightweight yet deliver a higher throughput. At Hamamatsu Photonics we are developing unique products to meet the new needs of rapidly evolving flow cytometers.



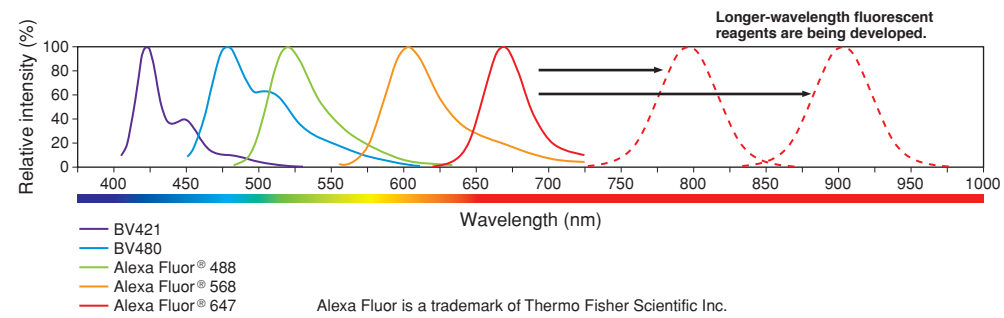
Photosensor Modules (InGaAs Photocathode)

Dev.

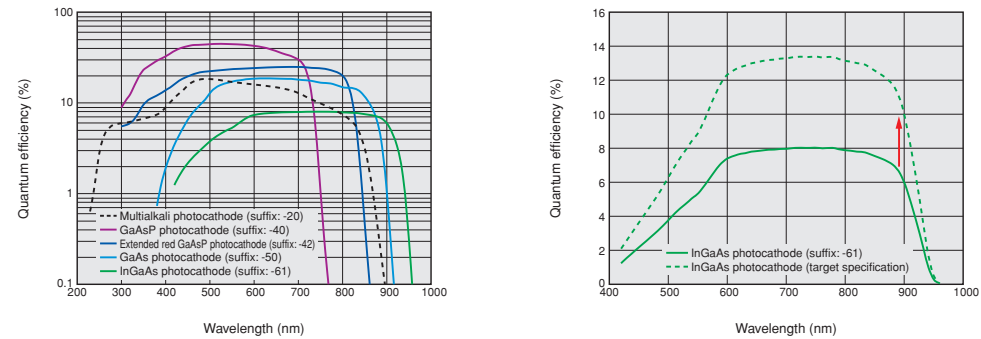
Photomultiplier tube modules with high sensitivity at 900 nm

These photosensor modules incorporate an InGaAs photocathode having a spectral response range from 420 nm to 940 nm and optimized for multicolor flow cytometry requiring fluorescent reagents for longer wavelengths. To achieve satisfactory operation at these longer wavelengths for reagents, we have newly developed an InGaAs photocathode that follows up on the currently used GaAsP, extended GaAsP, and GaAs photocathodes. We will continue to aim for higher sensitivity to help improve flow cytometer's performance.

Fluorescence spectra of fluorescent reagents (Typ.)



Spectral response (Typ.)



Linear Multianode Photomultiplier Tube Module H15441-20

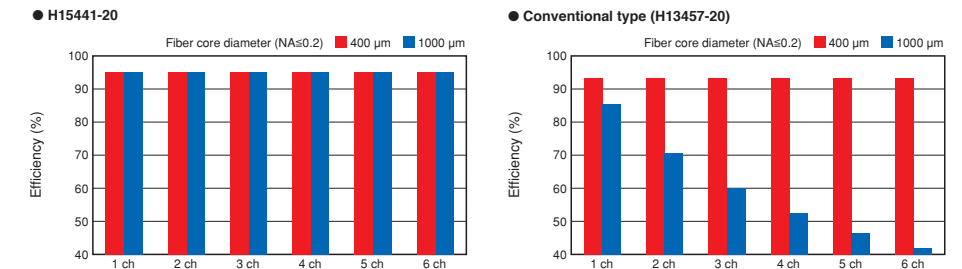
Dev.



Photomultiplier tube modules that perform simultaneous multi-wavelength measurements with high accuracy

The H15441-20 is a palm-sized 6-channel spectrum detector module capable of simultaneous multi-wavelength measurements. It utilizes a high-performance optical system that ensures low noise and compatibility with optical fibers (NA \leq 0.2) having an effective core diameter of 1000 μ m, scaled up from 400 μ m supported by our currently available product (H13457-20). The internal filters can also be customized according to the fluorescence and scattered light to be measured.

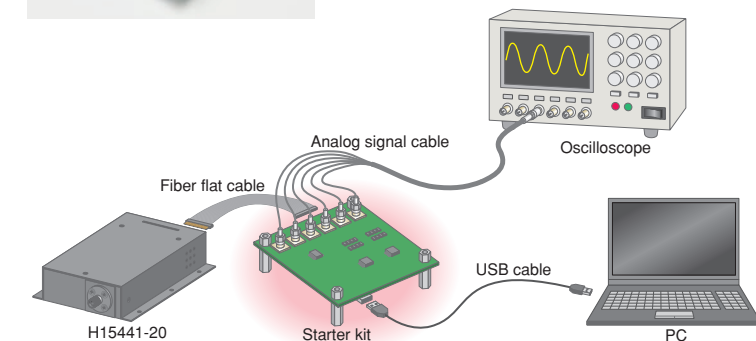
Spectral efficiency of optics (Typ.)



Starter kit for simple evaluation



We also offer a starter kit that includes a drive circuit for the H15441-20. This starter kit has a USB port for connecting to a PC to use the supplied sample software that controls a \pm 5 V power supply, operating voltage, gain adjustment of each channel, and data acquisition. It also has an SMB terminal that outputs a signal for making measurements with an oscilloscope, etc.



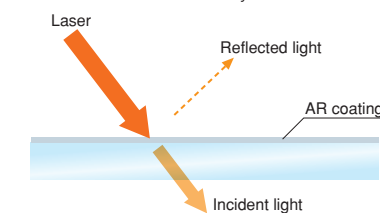
Flow Cells – AR (Antireflection) Coating

Dev.

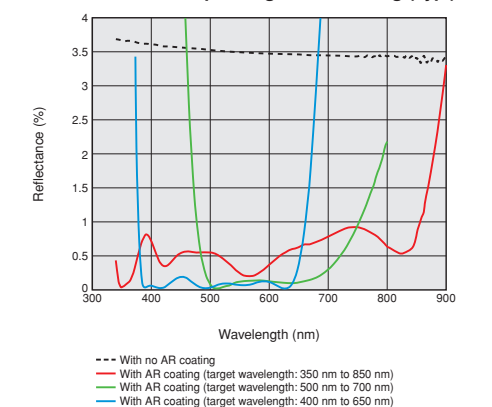


Flow cells with low reflectance over a broad spectral range

A flow cell is a glass product having an optical surface capable of optical measurement as well as having a flow path for the samples. The laser wavelength range for flow cytometers is expanding to cover a broad spectrum from the UV to near infrared region. To keep up with this broader wavelength range, we have added new products to our flow cell lineup which have an AR coating to exhibit low reflectance over a broad spectral range. This will reduce laser noise or namely stray light, and improve the flow cytometer's measurement sensitivity.



Reflectance after depositing an AR coating (Typ.)



In Vitro Diagnostics



Many diseases and infections are diagnosed by examining cells, genes, components, bacteria and viruses contained in a specimen (sample to be inspected). Hamamatsu Photonics provides high sensitivity detectors with various features that meet recent ever-increasing demands for quick and accurate inspections and will expand their potential applications.

MTP Reader (Microplate Reader)



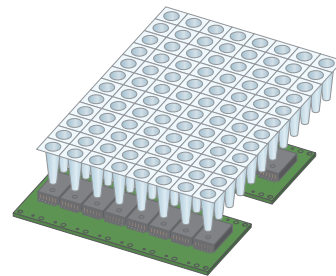
Micro PMT Module H15691-008

Dev't

Compact design photomultiplier tube module capable of multi-channel simultaneous measurements

The H15691-008 is an 8-channel micro PMT module using R15320U series surface-mount package micro PMTs arrayed in parallel so that the center-to-center spacing of each light-sensitive area is 9 mm to match the well-to-well spacing for 96-well microplates. Since each channel is individually arranged on the printed circuit board, no signal crosstalk occurs. The H15691-008 makes simultaneous measurements of multiple specimens, and in this way helps improve measurement accuracy and also reduces measurement time. The number of channels and photocathode materials can be flexibly customized to match user needs.

Example of use



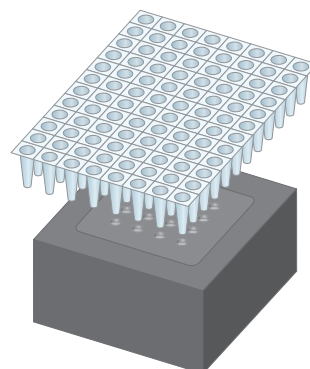
Photon Counting Head H14870

NEW

Photomultiplier tube module for 16-channel simultaneous photon counting

The H14870 is a photomultiplier tube module for 4x4 channel MTP readers, designed so that the center-to-center spacing of each light-sensitive area is 9 mm to match the well-to-well spacing for 96-well microplates. The H14870 makes 16-channel simultaneous measurements with low crosstalk and in this way helps reduce the measurement time to achieve higher throughput.

Example of use



Immunochromato-Reader



Immunochromato-Reader C10066-60

NEW

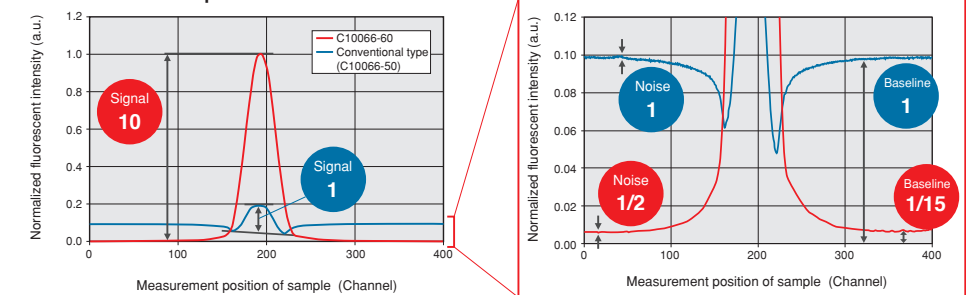
Fluorescent immunochromatography reagent reader ideal for fluorescent reagent R&D tasks

The C10066-60 is an Immunochromato-Reader that reads fluorescent immunochromatography (lateral flow) reagents with high sensitivity and high reproducibility achieved via our unique signal processing and optical design technologies. The C10066-60 is a promising tool for improving the R&D efficiency of immunochromatography reagents since it makes highly sensitive tests of reagent reactions to antigens such as viruses and hormones and also to antibodies that react with viruses, etc. We also welcome OEM requests, so please feel free to contact us.

Features

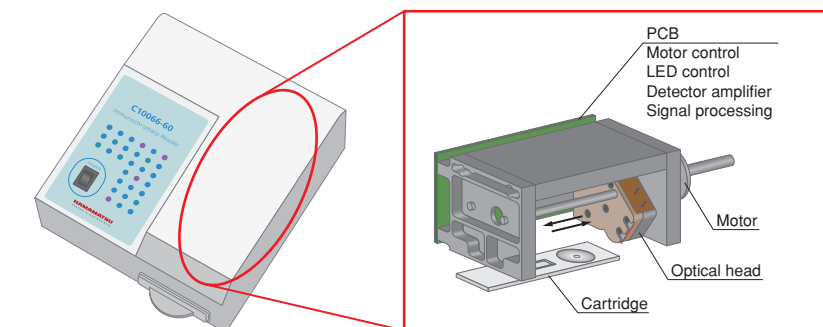
- High sensitivity: More than 10 times higher than our previous product
- High reproducibility: Industry's highest coefficient of variation (CV 3 %)

Measurement example

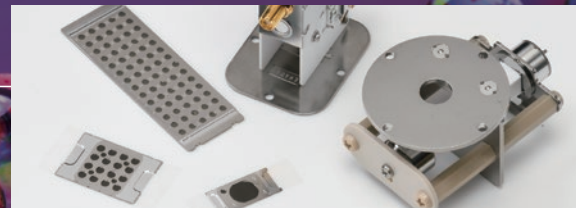


OEM example

As an OEM unit, we supply the "optical engine" that is the heart of C10066-60 series Immunochromato-Readers. This unit is designed to be compact yet has performance equivalent to C10066-60 series readers including all functions from detection to data output, and in this way supports rapid development of equipment by users.



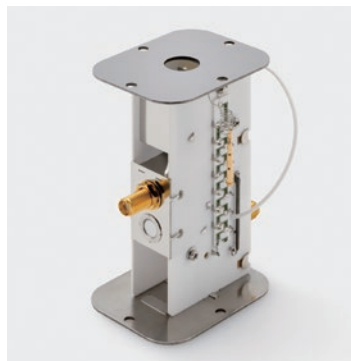
Mass Spectrometry (MS)



Mass spectrometry (MS) can identify and quantify a substance by ionizing the atoms and molecules of the substance and measuring the mass and number of ions. It is a well-known and effective analytical technique and research tool.

We contribute to progress in the mass spectrometry field by developing advanced ion detection devices in addition to supplying MCP and electron multipliers.

ICP-MS (Inductively Coupled Plasma MS)



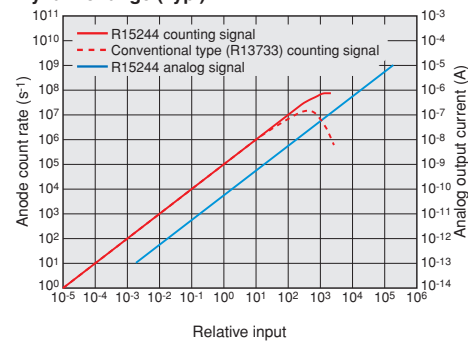
Dual Mode Ion Detector R15244

Dev.

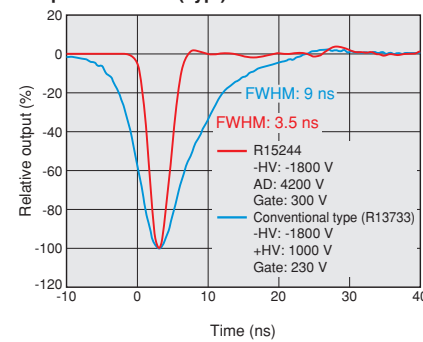
A new type of ion detector that delivers a wide dynamic range and long service life

The R15244 is a new type of ion detector utilizing a combination of electron multiplier and semiconductor AD (avalanche diode). Compared to our currently available product (R13733), the R15244 offers better time response characteristics, longer service life and a wider dynamic range.

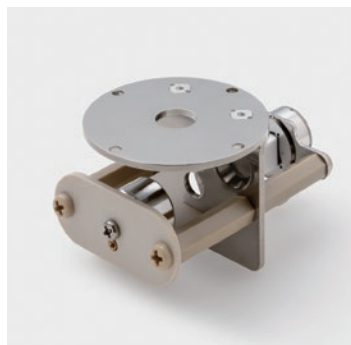
Dynamic range (Typ.)



Output waveform (Typ.)



Q-MS (Quadrupole MS)



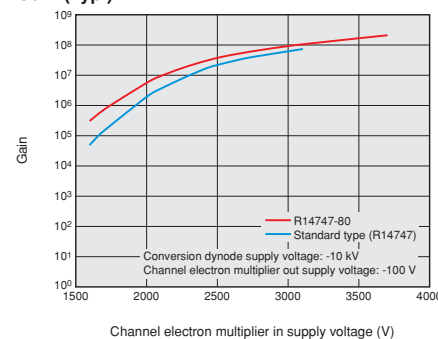
Ceramic Channel Electron Multiplier CERARION® R14747-80

Dev.

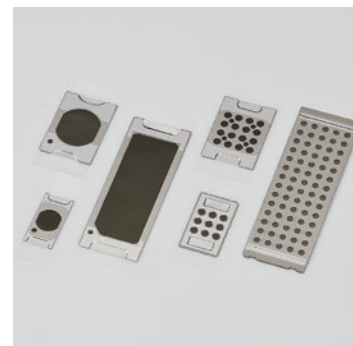
Lead-free ion detector customizable to meet user equipment specifications

CERARION is a lead-free channel electron multiplier that employs a ceramic structure with high design flexibility and robustness. The shape and the number of channels can be customized to meet user equipment specifications. When mounted with a conversion dynode, CERARION can measure ions of both polarities by changing the polarity of the voltage applied to the conversion dynode.

Gain (Typ.)



MALDI-MSI



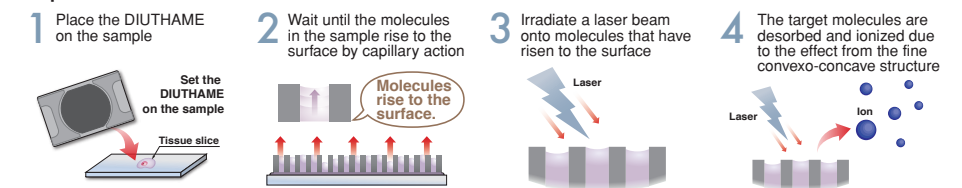
Ionization-Assisting Substrates DIUTHAME®

NEW

Ionization measurement support tool broadens the range of possible applications with an expanded lineup

DIUTHAME is an ionization-assisting tool that eliminates the matrix required by the MALDI technique. Just placing a DIUTHAME substrate on a sample swiftly promotes ionization. There is no background noise originating from the matrix, and no pretreatment of samples is required. DIUTHAME brings high reproducibility and ease-of-handling to mass spectrometry by serving as a completely new ionization tool that can be readily used by all MALDI mass spectrometer users.

Principle



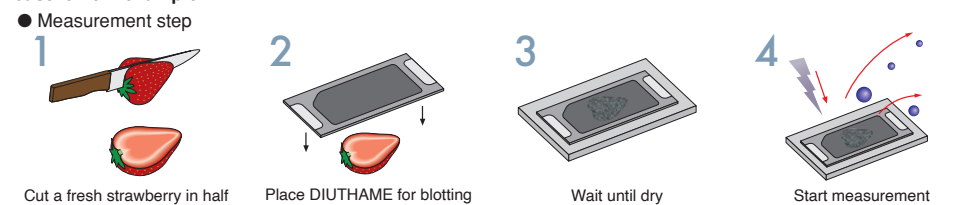
Specifications

Type	Type no.	Number of channels	Channel diameter	Blotting
For mass imaging Products can be selected according to the size of the measurement sample	A13331-10-1 NEW	1	φ10 mm	—
	A13331-10-1B NEW			✓
	A13331-18-2		49 mm × 18 mm	—
	A13331-18-2B			✓
	A13331-5019-1			—
A13331-5019-1B	✓			
For mass spectrum Multiple channels enable efficient measurement	A14111-3-1	9	φ3 mm	—
	A14111-3-2 NEW	16		
	A14111-3-3 NEW	70		

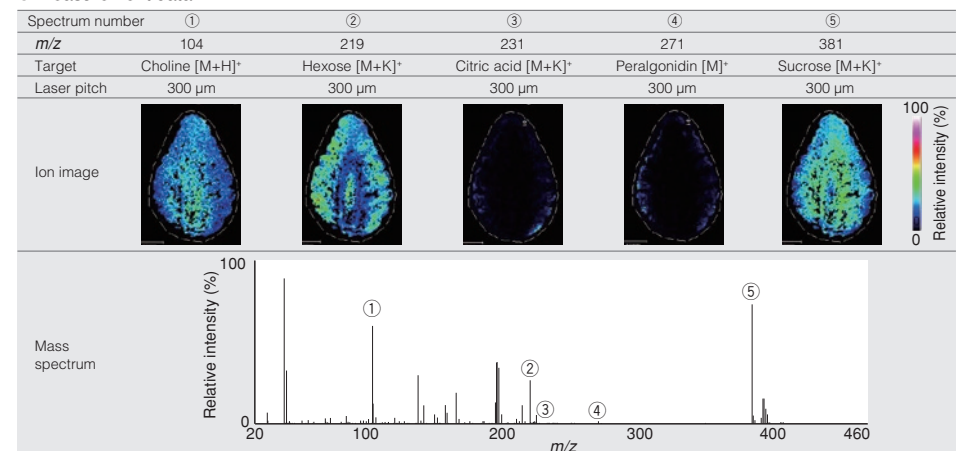
Blotting technique expands the application range of mass spectrometry imaging

In mass spectrometry imaging, samples must be sliced to a thickness of about 10 μm. However, it is difficult to slice samples with high water content such as strawberries and hard samples such as industrial materials. The blotting technique is used to transfer the components on the sample surface to the DIUTHAME substrate without thin-slicing the sample. The transferred components can then be analyzed by mass spectrometry imaging that retains position information. This will allow mass spectrometry imaging to expand its applications into fields where it could not be used up to now due to limits on sample sizes and measurement methods.

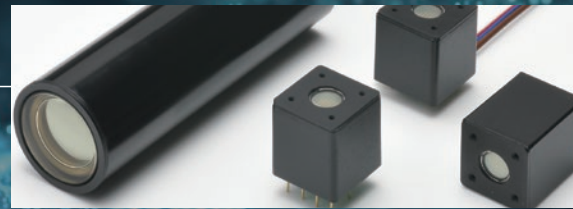
Measurement example



Measurement data



Underwater Optical Communication



In underwater environments (mostly in the ocean), wireless communication by sound waves (acoustic waves) has been widely used. However, the speed and amount of data transmittable through acoustic communication are limited. This is why optical communication using light is now the focus of attention for solving issues with current underwater wireless communication.

High Energy Physics Research



Hamamatsu photomultiplier tubes are widely used for cutting-edge high energy physics research being conducted by scientists around the world such as at Super-Kamiokande in Japan. We are pursuing the ultimate in photomultiplier tube performance by working to develop new technologies to optimize our products to serve as ideal matches for various experiments.



Photosensor Modules H14447, H14990-100-02, H14600-100, H14601-100 NEW

Photomultiplier tube modules capable of 1 Gbps communication

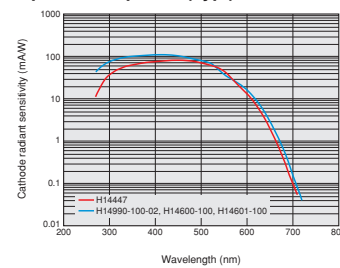
These photosensor modules have a fast response of 1 GHz (H14447), 0.8 GHz (H14990-100-02), and 0.2 GHz (H14600-100, H14601-100). These modules have specifications that ensure a wide opening in the eye pattern making them ideal for underwater optical communication. These also allow real-time analysis of large volumes of data and will likely be used for streamlining inspections of infrastructure equipment and for undersea resource exploration.

* In addition to the H14600-100 and H14601-100 that operate with a +5 V input, the lineup includes H14950-100 and H14953-100 that operate with a +15 V input.

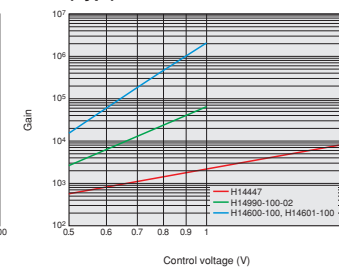
Features

- Fast response capable of high-speed communication
- Wide effective area for easy optical axis alignment of receiver and transmitter
- High gain for extending communication range

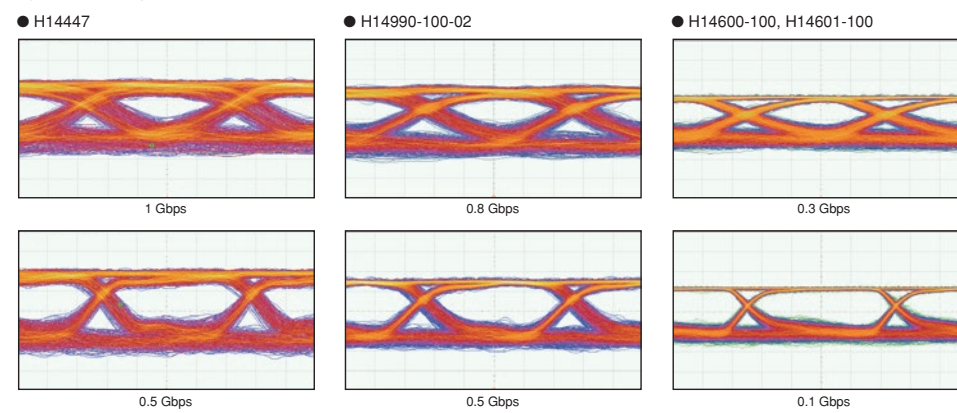
Spectral response (Typ.)



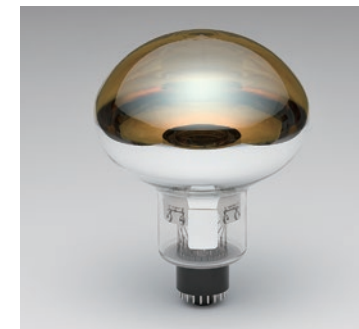
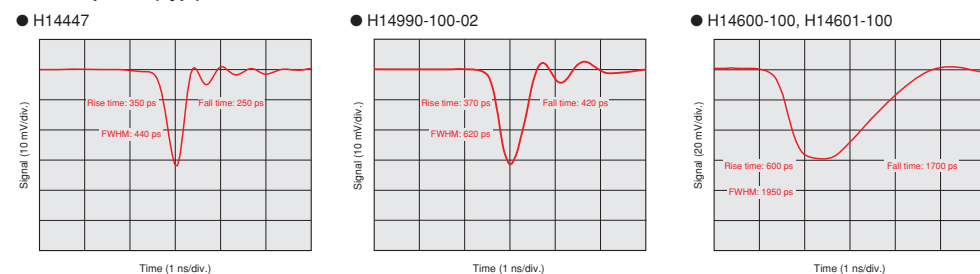
Gain (Typ.)



Eye pattern (Typ.)



Time response (Typ.)



Photomultiplier Tube R14688-100 NEW

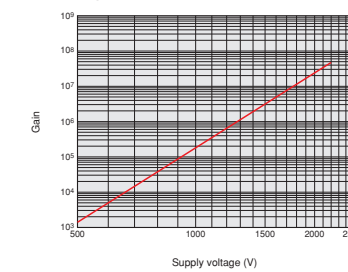
8-inch diameter photomultiplier tube with high gain and high time resolution

The R14688-100 is a hemispherical head-on photomultiplier tube optimized for neutrino observation. Compared to our previous product (R5912-100), the R14688-100 exhibits higher time resolution and a larger field-of-view angle that minimizes so-called dead space when installed.

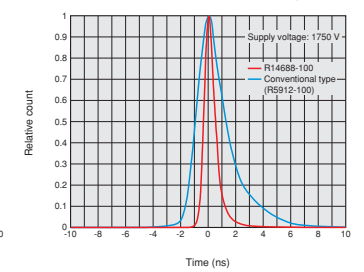
Features

- High gain: 1.0×10^7 (typ.)
- High time resolution: Transit time spread (FWHM) 0.9 ns (typ.)

Gain (Typ.)



Transit time spread (FWHM) (Typ.)

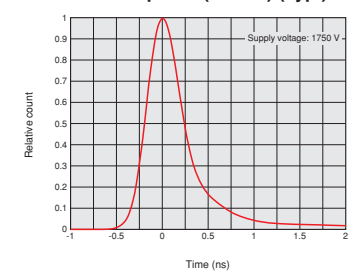


Photomultiplier Tube R15608 NEW

3-inch diameter photomultiplier tube with excellent time resolution

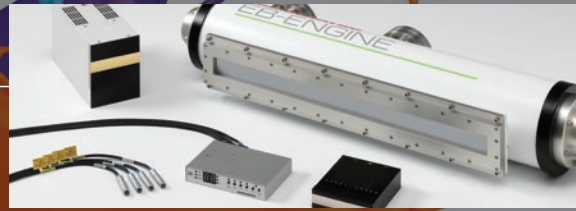
The R15608 is a 3-inch diameter head-on photomultiplier tube that was newly added to our product lineup of fast response photomultiplier tubes. It employs a newly designed electrode structure and a plano-concave faceplate that achieve even better time resolution while having a large diameter.

Transit time spread (FWHM) (Typ.)



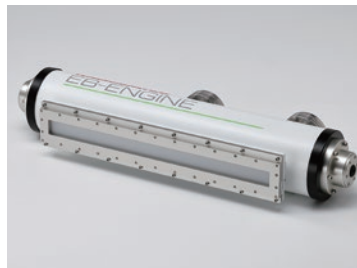
Specifications

Type no.	Diameter	T.T.S. (FWHM) (Typ.)
R13478	25 mm (1 inch)	130 ps
R13449	28 mm (1-1/8 inch)	170 ps
R13408	38 mm (1.5 inch)	190 ps
R13089	51 mm (2 inch)	230 ps
R15608 NEW	76 mm (3 inch)	400 ps



For the printing industry where there are ever-increasing demands for higher speed, higher quality, and higher added values, Hamamatsu Photonics offers products for EB and UV printing that were developed with photonics technology.

EB Printing



Low Energy Electron Beam Source EB-ENGINE™ - Long Type

Dev.

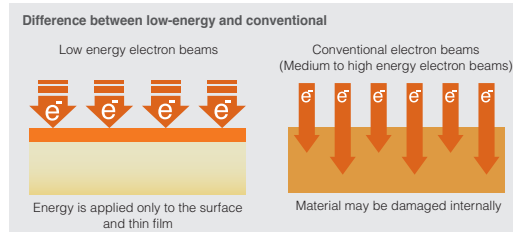
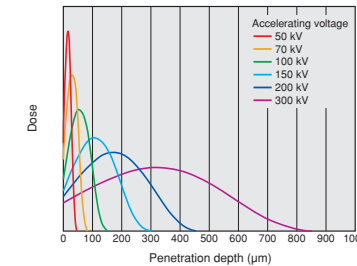
Model with greatly improved processing capacity and compatible with high-speed transport

This EB-ENGINE is a low energy electron beam source that is well-suited for high-speed transport requiring instant curing of radical polymerization ink such as EB ink. It has a wide effective processing width of 450 mm or 650 mm and emits high-density, low energy electron beams that ensure streamlined, high-speed EB printing. The EB-ENGINE also offers advantages that help reduce equipment size and weight, simplifies shielding enclosures and cuts the total cost, making it easier to install and use.

Features

- Enhanced processing effect on surfaces and thin films (low accelerating voltage: 50 kV to 100 kV)
- High processing capability: 30 kGy at a rate of 100 m/min
- Wide effective processing width: 450 mm or 650 mm
- Easy to install on printer lines due to small, lightweight body and simple X-ray shielding
- Easy maintenance

The depth-dose distribution in water of an incident electron



UV Printing

Linear Irradiation Type UV-LED Unit LIGHTNINGCURE® LC-L5G

Dev.

The LC-L5G series is a family of UV-LED light sources that instantly dry UV ink used for ink-jet printers, flexographic printers, and screen printers. By using the *ThoMaS* unique air-cooling method for higher output and by quickly and flexibly responding to requests for custom products, we provide UV-LED light sources that precisely meet user needs. We also support users in various ways such as by offering the *ALICE* product warranty extension service, a quality evaluation service, and a demo unit service.

Features

- Unique air-cooling method *ThoMaS*
The *ThoMaS* unique air-cooling method consists of 3 elements that deliver the industry's highest-level cooling power despite its compact and lightweight design.
 - ▶ Thermal analysis technology (Thermal observation)
 - ▶ Unique cooling material (Material)
 - ▶ Unique cooling structure (Sylphy air)
- Quick and flexible customization
We provide a wide lineup and customized products to meet user requests such as for size, output power, wavelength, lighting mode, software, and interface.
- Product warranty extension option *ALICE*
Based on the user's operating conditions and usage environment, we consider extending the warranty period which is usually one year after delivery.



GH-103A

Dev.

High-end model with industry's highest output power (air-cooling, 24 W/cm²) in its

By taking advantage of our unique optical technology and cooling technology, we are developing UV-LED light sources that achieve even higher output power than ever before. This light source will prove ideal for printing ink and printer transport speeds that could not be handled until now.

Features

- High output power: 24 W/cm²
- Capable of segment lighting
- RS-485 communication
- Supports multi-unit operation

Specifications

- Light emitting window size: 103 mm × 24 mm
- Wavelength: 395 nm
- UV irradiance^①: 24 W/cm²

NOTE: ① Maximum UV irradiance within the area irradiated by the light source positioned at a distance of 0 mm from the irradiated area.

GC-113A

Dev.

High-power pinning model capable of segment lighting

This UV-LED light source delivers high output power, enough to allow high-speed paper transport and effective pinning of white ink. Using the RS-485 communication also improves the versatility and ease of use.

Features

- High output power: 10 W/cm²
- Capable of segment lighting
- RS-485 communication
- Supports multi-unit operation

Specifications

- Light emitting window size: 113 mm × 16 mm
- Wavelength: 365 nm, 385 nm, 395 nm
- UV irradiance^①: 7.5 W/cm² (at 365 nm), 10 W/cm² (at 385 nm and 395 nm)

NOTE: ① Maximum UV irradiance within the area irradiated by the light source positioned at a distance of 0 mm from the irradiated area.



UV-LED Spot Light Source LIGHTNINGCURE® LC-L1V5

Dev.

Deep UV model expected to open new applications

The LC-L1V5 is a UV-LED spot light source that emits deep UV light at a wavelength of 280 nm. Using deep UV light along with UV light improves the surface curability of ink. The LC-L1V5 can also be used for development (evaluation and testing) of inks. When an optical system such as a condenser lens is mounted, it will emit deep UV light in a wide variety of irradiation patterns. Please feel free to contact us for further information and requests.



Bonding

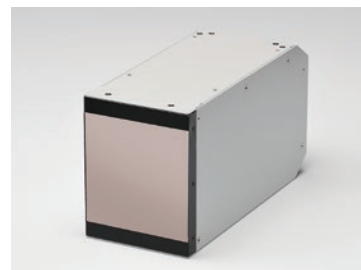


UV bonding is quick and generates little heat, so these features ensure its wide use in manufacturing processes to join various components together such as for bonding liquid crystal and organic EL panels or for clamping camera modules into smartphones. We propose products optimized for UV bonding to help users improve their manufacturing throughput even further.

Electrostatic Charge Removal



Hamamatsu Photonics provides a variety of static charge removers that neutralize static electricity by utilizing photoionization known as a clean ionization method. Photoionization proves a powerful tool for solving problems with static charges that have recently arisen in production processes and other tasks, and in this way improves both the throughput and yield.



Linear Irradiation Type UV-LED Unit LIGHTNINGCURE® LC-L5G GA-108 Dev.

Large-area irradiation model capable of irradiating large samples all at once

The LC-L5G GA-108 is a large-area type UV-LED light source that can be flexibly designed to match the manufacturing process. Its large irradiation area allows irradiating large samples all at once which has been difficult to do up to now. Using this UV-LED light source in a UV curing furnace will also help cut running costs.

Features

- Large-area irradiation
- High output power: 1.5 W/cm²

Specifications

- Light emitting window size: 108 mm x 107 mm
- Wavelength: 365 nm
- UV irradiance^①: 1.5 W/cm²

NOTE: ① Maximum UV irradiance within the area irradiated by the light source positioned at a distance of 10 mm from the irradiated area.



UV-LED Spot Light Source LIGHTNINGCURE® LC-L1V5 Dev.

Deep UV model is the hoped-for answer to removal of UV adhesive tack

The LC-L1V5 is a UV-LED spot light source with 4 independently driven heads, each of which is small enough to fit in the palm of your hand and emits deep UV light at 280 nm. Deep UV light allows removing the tack on the surface of UV curable adhesive. A wide range of irradiation patterns are available by installing an optical system such as a condenser lens. Please feel free to contact us for further information and requests about deep UV.



L12542



L15094

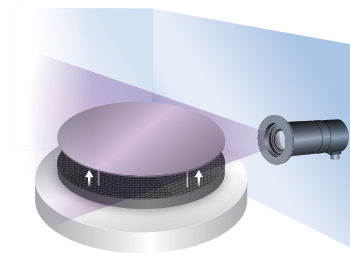
Electrostatic Charge Removers VUV Ionizer L12542, L15094

Static eliminator with high performance for neutralizing static charges in a vacuum

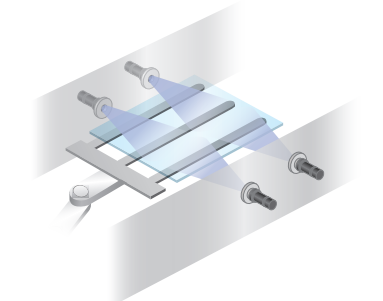
The L12542 and L15094 eliminate static charges in a vacuum by utilizing vacuum UV light. Due to their greatly improved neutralization performance over larger areas, they can handle a variety of objects with large surface areas, with heavy electrical charges, or moving on high-speed conveyors, and in this way help shorten the neutralization time.

Applications

- Dechucking of electrostatic chuck
- Semiconductor manufacturing
- Liquid crystal and organic EL display manufacturing
- Film manufacturing
- Equipment using electron beams (SEM, etc.)



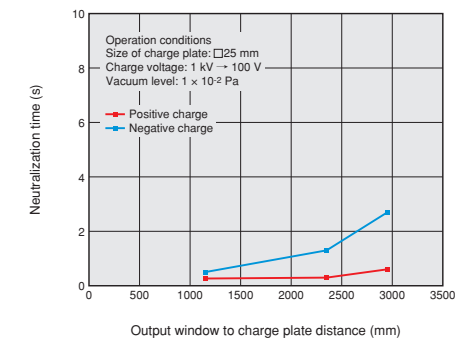
Dechucking of electrostatic chuck



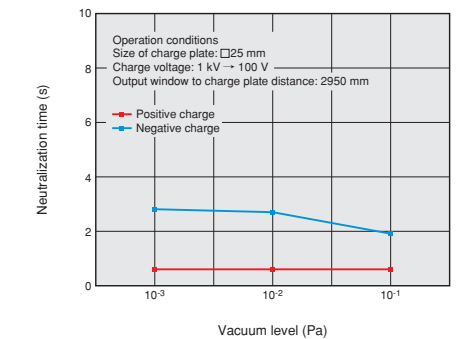
Liquid crystal and organic EL display manufacturing

Neutralization performance (Typ., L15094)

● Neutralization time vs. distance



● Neutralization time vs. vacuum level



X-ray Non-destructive Inspection



In recent years, high-speed and high-precision inspection and analysis are required in a broad range of diverse industries, including automotive, electronics and food industries that have continued to evolve at a dizzying pace. X-ray non-destructive inspection will meet such market demands since it is capable of non-contact and non-destructive real-time inspections and analyses of the structure and properties of objects.



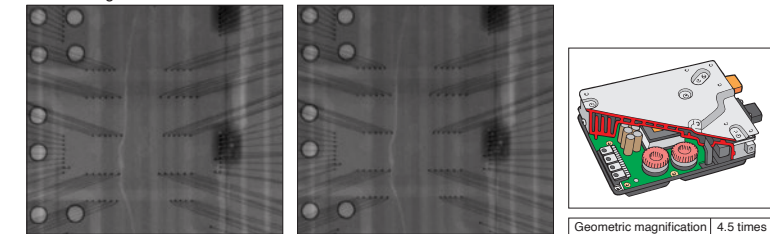
180 kV Microfocus X-ray Source L14351-02

Sealed type X-ray source with the world's highest tube voltage of 180 kV maximum

The L14351-02 is a sealed type microfocus X-ray source that achieves the world's highest tube voltage (maximum tube voltage 180 kV) and high output (maximum output 90 W). In addition to high resolution (up to 10 μm), it handles samples that are normally difficult to view using sealed type X-ray sources. It also improves the imaging speed.

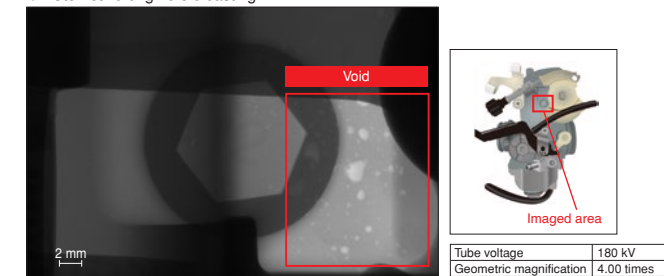
Imaging example (In-line inspection)

● ECU: Engine Control Unit



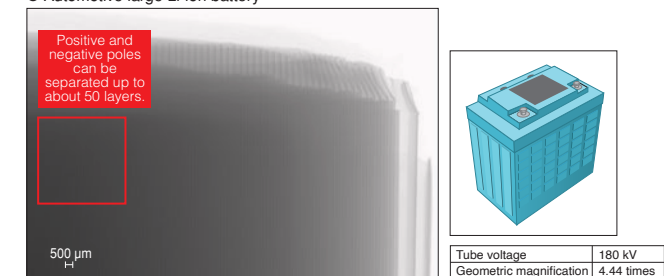
180 kV Exposure time: 1 sec
150 kV Exposure time: 2 sec
Captures X-ray image equivalent to that captured at 150 kV in half the time

● Automotive engine die casting



Tube voltage 180 kV
Geometric magnification 4.00 times

● Automotive large Li-ion battery



Tube voltage 180 kV
Geometric magnification 4.44 times

* This image was captured while the object was kept still.



Soft X-ray Source L11754-01W

NEW

Soft X-ray source that operates at low energy for detecting foreign objects

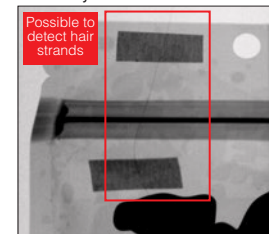
The L11754-01W is a soft X-ray source that emits low energy X-rays for finding light-element foreign objects that were difficult to detect up to now. The L11754-01W is small and lightweight, and has a wide X-ray emission angle, making it easy to install in compact inspection equipment. It proves ideal for inspection applications such as finding poor package sealing on foodstuff and medicine containers or detecting misaligned rechargeable battery separators.

Features

- Low energy: Tube voltage 15 kV
- Low tube voltage eliminates the need for lead shielding
- Small and lightweight
- Wide X-ray emission angle

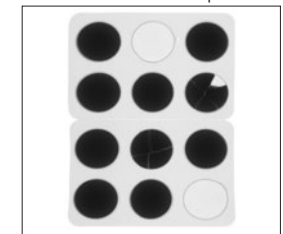
Imaging examples

● Gummy

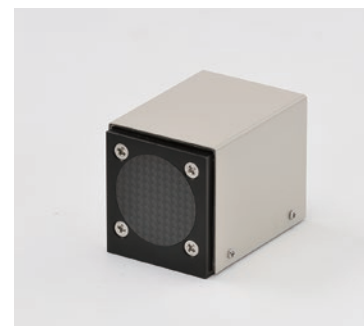


Tube voltage 15 kV
Tube current 1.0 mA
Detector C12300-321B

● Tablets in aluminum foil pouch



Tube voltage 15 kV
Tube current 1.0 mA
Detector C12300-321B



Compact X-ray CMOS Camera DX-CUBE™ H8953-30

NEW

Easy-to-handle X-ray camera for capturing high-definition X-ray images

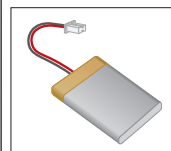
The DX-CUBE H8953-30 is a compact CMOS camera using a consumer CMOS camera in combination with a high-sensitivity CsI scintillator that we developed totally in-house. It makes high-definition X-ray imaging just as easy as handling an ordinary CMOS camera.

Features

- Compact, lightweight
- High resolution
- High sensitivity

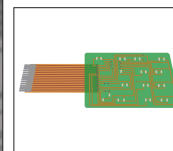
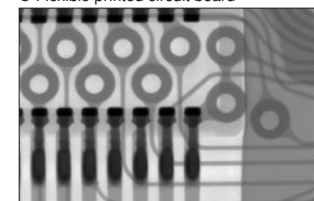
Imaging examples

● Li-ion battery + protection circuit



Tube voltage 100 kV
Geometric magnification 1.4 times

● Flexible printed circuit board



Tube voltage 100 kV
Geometric magnification 3.1 times



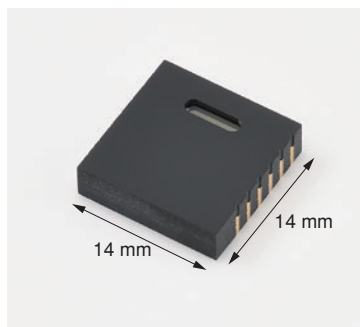
Micro PMT

Micro PMT is the world's smallest, thinnest and lightest photomultiplier tube developed by taking advantage of our unique advanced technologies in MEMS (Micro-Electro-Mechanical Systems), semiconductor manufacturing, electron trajectory design, vacuum-sealed packaging and vacuum processing. Micro PMT is a promising device with a highly diverse range of applications since it provides high sensitivity and fast time response, and allows reducing the equipment size while maintaining good performance.

Standard Models with a High Degree of Freedom in Design

Surface-Mount Package Micro PMT R12900U Series

NEW



Micro PMT sealed in a small, thin and light package for easy mounting on circuit boards

The R12900U series is a micro PMT encapsulated in a plastic package designed for easy mounting by the user onto electronic circuit boards. To meet increasing demands for more portable equipment, the R12900U series offers great features including a smaller size, thinner profile, lighter weight and easier installation. These features allow creating a free and flexible design during equipment development.

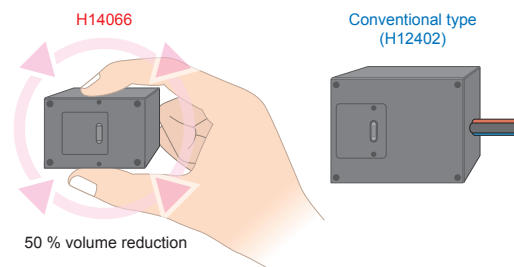
Micro PMT Modules H14066 Series

NEW

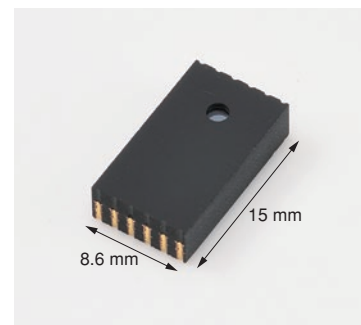


The world's smallest photomultiplier tube module that easily operates from a simple low voltage supply

The H14066 series is the world's smallest micro PMT module that integrates a micro PMT with a voltage-divider circuit and a high-voltage power supply circuit. The H14066 series incorporates an R12900U series surface-mount package micro PMT. Compared with our currently available micro PMT module (H12402), the H14066 series is downsized about 50% in volume, helping the design of more portable equipment. It also easily operates from a low voltage supply that makes it quick and easy to start using.



The World's Smallest Models Enabling Multi-Channel Measurement



Surface-Mount Package Micro PMT R15320U Series

Dev't.

Photomultiplier tube designed even smaller to allow a parallel array configuration

The R15320U series is a micro PMT encapsulated in a plastic package designed for easy mounting onto printed circuit boards. The package size is further reduced to 8.6 mm x 15 mm. Arraying multiple micro PMTs in parallel not only allows downsizing the equipment but also supporting multi-functions such as simultaneous measurement of multiple samples and detection of multiple wavelengths with a single unit.

Multi-Wavelength Detection Unit

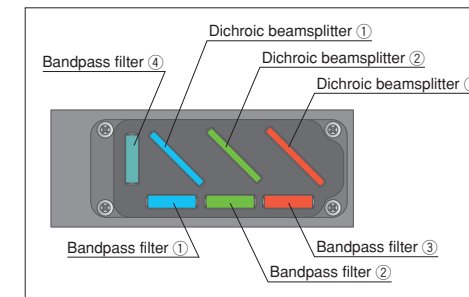
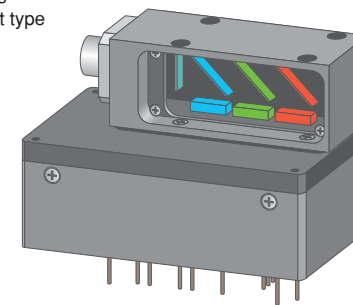
Technology

Highly flexible detection unit capable of multi-channel and multi-wavelength measurements

This is a compact multi-wavelength detection unit using R15320U surface-mount package micro PMTs. This unit enables making multi-channel simultaneous measurements or multi-wavelength measurements with no crosstalk since each channel is separate. The optical path length is minimized at a minimum channel pitch, which allows increasing the light condensing efficiency by using an optical system even if using optical fibers with a large core diameter. This unit can be flexibly customized to match individual user needs such as for the number of channels and measurement wavelengths.

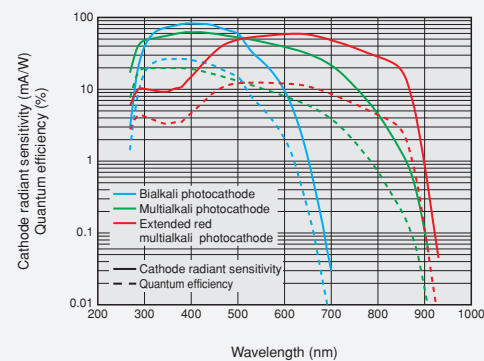
Standard model

3 channels
Fiber input type

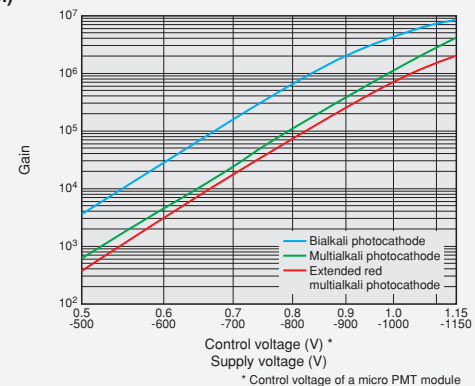


- A photocathode with the spectral response characteristics you need can be selected for each channel.
- The gain of each channel can be adjusted independently (wide gain adjustment range).
- A filter suitable for the customer's application can be installed.

Spectral response (Typ.)



Gain (Typ.)



Applications

- Environmental analysis
- In vitro diagnostics (POCT: point-of-care testing)
- Various portable devices





Infrared (IR) Light Sources

Our product lineup includes advanced infrared light sources that have outstanding features compared to thermal type light sources such as halogen lamps. Our infrared light sources will help users achieve their objective and meet requirements in a wide range of applications including capnography, gas measurement, gas analysis and infrared spectroscopy.



IR Graphene Light Source L15969

NEW

Thermal mid-infrared light source with high brightness and fast time response

The IR graphene light source is a thermal mid-infrared light source that operates at high temperatures to emit black body radiation. Besides high temperature operation, the IR graphene light source offers excellent features such as faster time response and lower power consumption compared to conventional thermal light sources, making it a promising tool for a wide range of applications.

Features

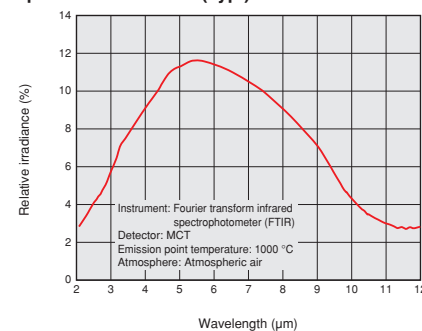
- High temperature operation: Emission point temperature approx. 1000 °C
- Fast time response: 3000 Hz (max.)
- Low power consumption: 1000 mW (typ.)
- Broad emission spectrum: 1 μm to 7.5 μm
- Emission point size: 100 μm × 2000 μm

Applications

- Capnography (CO₂, etc.)
- Non-dispersive infrared (NDIR) gas measurement and analysis
- Fourier transform infrared spectroscopy (FTIR) gas measurement and analysis

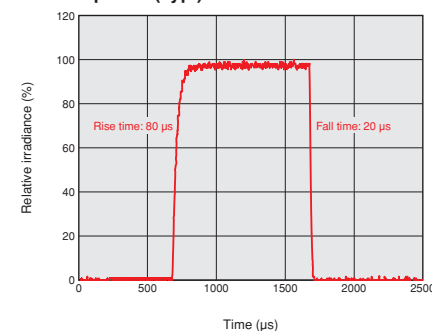


Spectral distribution (Typ.)



* Spectral distribution depends on the atmospheric components.

Time response (Typ.)



Xenon Flash Lamp

Pulsed light source that emits a broad infrared spectrum

This xenon flash lamp is an infrared light source that emits a broad spectrum spanning from 0.16 μm to 7.5 μm. Compared to other types of infrared light sources, this xenon flash lamp features low heat generation, stable operation and momentarily high optical output. It also delivers a long service life and ensures high reliability.

Applications

- Food analysis, foreign matter inspection, food sorting
- Gas measurement and analysis
- Infrared spectroscopy



Imaging Devices

Imaging technology enables high-precision inspection, measurement and analysis and is used in a vast range of fields. These uses include capturing instantaneous images and low level light in UV to infrared regions. Here at Hamamatsu Photonics we are constantly developing products with the aim of easy yet highly accurate imaging.



High-Speed Gated Image Intensifier Units C14245 Series

NEW

Compact image intensifier unit that captures momentary emissions of faint light

The C14245 series consists of an image intensifier (or I.I.), a high-voltage power supply circuit and a gate drive circuit enclosed in a cubic housing. The cubic housing easily connects to the body of most large-sized, high-performance cameras, which has been difficult for the conventional type (C9546 series) that has an L-shaped configuration. The standard lens mount of the C14245 is a C-mount but can be easily changed to an F-mount if needed.

Applications

- Observation of high-speed phenomena (combustion, discharge, etc.)
- Observation of low light emission (bioluminescence, chemiluminescence, etc.)

Imaging example

- Observation of discharges on PC board

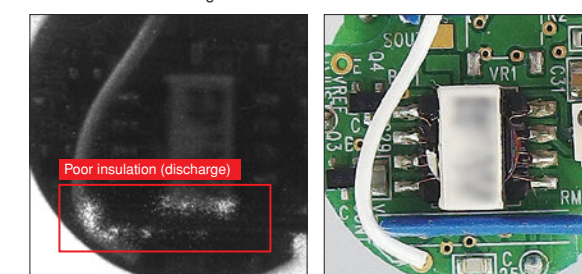
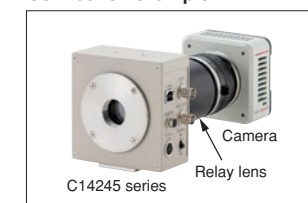


Image captured with C14245

Ordinary visible image

Connection example



Combining the C14245 image intensifier unit with a CMOS camera allows using it as an I-CMOS (intensified CMOS) camera.



High-Speed Gated Image Intensifier Units C16031 Series

Dev.

Image intensifier units with an image booster compatible with high-speed cameras

The C16031 series is a high-speed gated image intensifier unit designed for use with high-speed cameras. In addition to an image intensifier, high-voltage power supply circuit, and gate drive circuit, the C16031 series further contains an image booster in its cubic housing. When capturing and reading out images at a high frame rate, we recommend you use the C16031 series by connecting it to a high-speed camera.



Main Products

Opto-semiconductors

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

Electron Tubes

- Photomultiplier tubes
- Photomultiplier tube modules
- Microchannel plates
- Image intensifiers
- Xenon lamps / Mercury-xenon lamps
- Deuterium lamps
- Light source applied products
- Laser applied products
- Microfocus X-ray sources
- X-ray imaging devices

Imaging and Processing Systems

- Cameras / Image processing measuring systems
- X-ray products
- Life science systems
- Medical systems
- Semiconductor failure analysis systems
- FPD / LED characteristic evaluation systems
- Spectroscopic and optical measurement systems

Laser Products

- Single chip laser diodes
- Laser diode bar modules
- Quantum cascade lasers
- Direct diode lasers
- Applied products of semiconductor lasers
- Solid state lasers / Fiber lasers
- Laser related products

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Telephone/Fax: (27)11-609-0367

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* Information in this catalog is believed to be reliable. However, no responsibility is assumed for possible inaccuracies or omission. Specifications are subject to change without notice. No patent rights are granted to any of the circuits described herein. © 2021 Hamamatsu Photonics K.K.

* Please thoroughly read the precautions and the prohibited uses included in the user manual before installation and use.

Electron Tube Division, HAMAMATSU PHOTONICS K.K.

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