HAMAMATSU

PHOTON IS OUR BUSINESS

PHOTONIC DEVICES 2020

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.

Photonic Devices 2020
Electron Tube Devices and Applied

Products

INDEX

●NEW ●Devlp. ●Technology

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.

TOF-MS

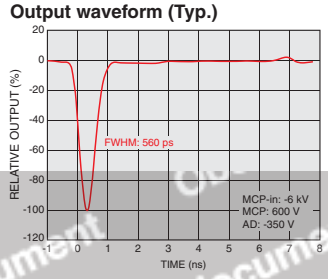
MCP Assembly MIGHTION® F14845-11

NEW

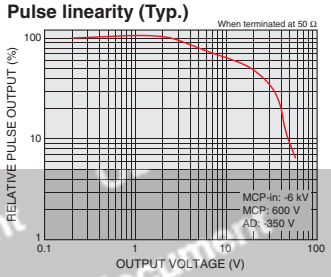
Ion detector with fast time response, high output linearity, and long service life

MIGHTION is an ion detector using a combination of MCP (microchannel plate) and semiconductor AD (avalanche diode). It features fast time response, high output linearity, and long life. MIGHTION also has a large effective area (27 mm dia.) ideal for TOF-MS (time-of-flight mass spectrometry).

Output waveform (Typ.)



Pulse linearity (Typ.)



Miniature MS

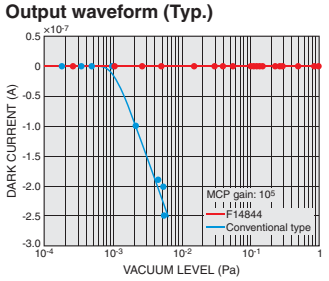
MCP Assembly F14844

NEW

Ion detector capable of operating at high pressure (low vacuum) and high gain: 10^6 at 1 Pa

The F14844 MCP assembly has a unique triode structure that suppresses ion feedback noise to ensure stable operation in high pressure (low vacuum) environments. The F14844 is an innovative ion detector that can be mounted in compact desktop mass spectrometers where installing large vacuum pumping systems is difficult or impractical.

Output waveform (Typ.)



Q-MS (Quadrupole MS)

Ceramic Channel Electron Multiplier CERARION® R14747-80

Devlp.

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.

ICP-MS (Inductively Coupled Plasma MS)

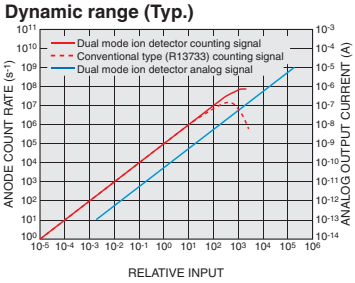
Dual Mode Ion Detector

Technology

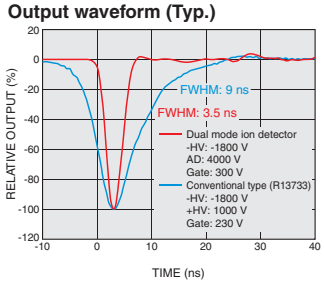
A new type of ion detector that delivers a wide dynamic range and long service life

This is a new type of ion detector using a combination of electron multiplier and semiconductor AD (avalanche diode). Compared to the conventional type (R13733), this detector delivers a wider dynamic range and longer service life achieved through improving the time response characteristics of counting signals.

Dynamic range (Typ.)



Output waveform (Typ.)



MALDI TOF-MS Imaging

Ionization-Assisting Substrates DIUTHAME® A13331-18-2B, A13331-5019-1B

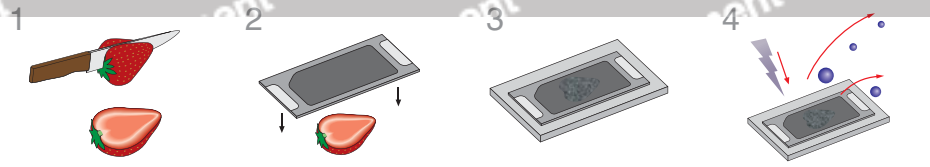
NEW

New measurement support tools optimized for blotting technique

DIUTHAME is an ionization-assisting tool that promotes ionization in place of the matrix used for MALDI. DIUTHAME works just by placing it on a sample before measurement. Since the A13331 series DIUTHAME is newly designed for use with the blotting technique, it can make imaging measurements that retain position information by transferring the components on the sample surface to the DIUTHAME substrate. There is no need to slice the samples, so DIUTHAME applications will now extend into fields where it could not be used up until now due to sample shapes and measurement methods.

Measurement example

●Measurement step

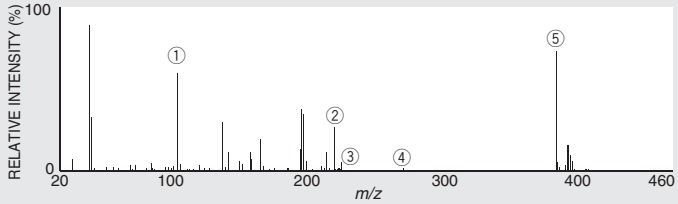


●Measurement data

Spectrum number	①	②	③	④	⑤
m/z	104	219	231	271	381
Target	Choline $[M+H]^+$	Hexose $[M+K]^+$	Citric acid $[M+K]^+$	Peralgonidin $[M]^+$	Sucrose $[M+K]^+$
Laser pitch	300 µm	300 µm	300 µm	300 µm	300 µm

Ion image

Mass spectrum



Printing

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

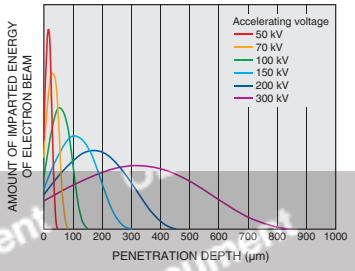
Low-Energy Electron Beam Source EB-ENGINE - Long Type

Devlp.

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

This EB-ENGINE is a low-energy electron beam source that is well-suited for high-speed paper transport requiring instant drying of radical polymerization ink such as EB ink. It has a wide effective processing span 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.

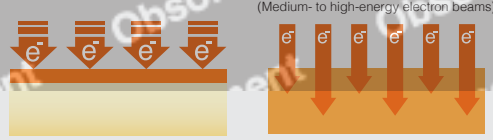
Amount of imparted energy and penetration depth of electron beam



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 span: 450 mm or 650 mm
- Compact and lightweight
- Easy maintenance

■Difference between low-energy and conventional



Energy is applied only to the surface and thin film

Material may be damaged internally

UV Printing

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

Devlp.

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. To meet user needs, Hamamatsu offers a wide lineup of products that can be customized in size, output power, lighting method (partial lighting, etc.), cooling method, and communication method.

GH-103A

High-end model with industry's highest output power (air-cooled 24 W/cm^2) in its class

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/cm^2
- Capable of segment lighting
- RS-485 communication
- Supports multi-unit operation

GC-113A

Devlp.

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/cm^2
- Capable of segment lighting
- RS-485 communication
- Supports multi-unit operation

GD-390

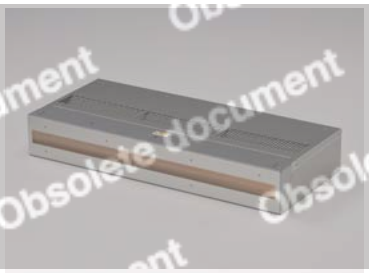
Devlp.

Duct-suction forced-air cooling model designed for improved compatibility with metal halide lamps

This light source is designed to have the same shape as a typical metal halide lamp and so serves as a direct replacement without needing any additional equipment.

Features

- High compatibility with metal halide lamps
- Forced-air cooling via suction ducts
- High output power: 18 W/cm^2
- Capable of segment lighting
- RS-485 communication



GB-360

Devlp.

High-uniformity model design to minimize irradiation non-uniformities

This UV-LED light source provides highly uniform irradiation patterns that prevent printing irregularities.

Features

- High output power: 7 W/cm^2
- Highly uniform irradiation: Within ±4 %
- Capable of segment lighting

Specifications

Model name	Light emitting window size	Wavelength	UV irradiance	Cooling method
GH-103A	103 mm × 24 mm	395 nm	24 W/cm^2 ①	Forced-air cooling by fan
GC-113A	113 mm × 16 mm	365 nm	8 W/cm^2 ①	Forced-air cooling by fan
		385 nm	10 W/cm^2 ①	
		395 nm		
GD-390	390 mm × 20 mm	385 nm	18 W/cm^2 ①	Forced-air cooling via suction ducts
GB-360	300 mm × 20 mm	385 nm	7 W/cm^2 ②	Forced-air cooling by fan

NOTE: ① Maximum UV irradiance within the area irradiated by the light source positioned at a distance of 0 mm from the irradiated area.
② Maximum UV irradiance within the area irradiated by the light source positioned at a distance of 5 mm from the irradiated area.

UV-LED Spot Light Source LIGHTNINGCURE® LC-L1V5

Devlp.

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.

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 SuperKamiokande 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.

Photomultiplier Tubes R14374, R14689

NEW

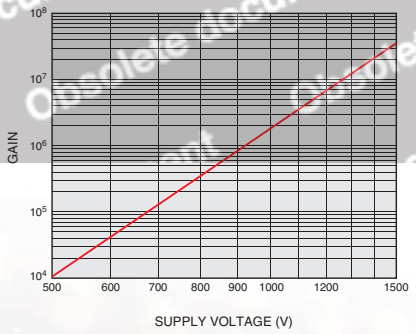
3-inch and 3.5-inch diameter hemispherical photomultiplier tubes with high gain and high time resolution

The R14374 and R14689 are small-diameter hemispherical photomultiplier tubes with high gain designed for use with the next generation neutrino telescope KM3NeT. Compared to the conventional hemispherical photomultiplier tube (R12199), the R14374 and R14689 exhibit higher time resolution that gives more accurate neutrino observation. Despite their small diameter, they offer a large field-of-view angle and also minimize the so-called dead space when installed.

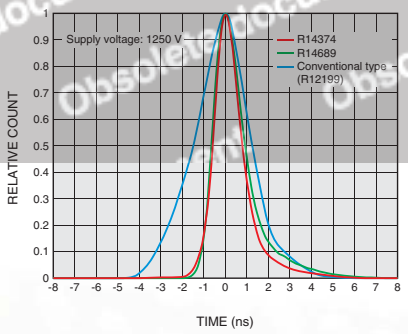
Features

- High gain: 1.0×10^7 (typ.)
- High time resolution: Transit time spread (FWHM) R14374: 1.3 ns (typ.)
  R14689: 1.5 ns (typ.)

Gain (Typ.)

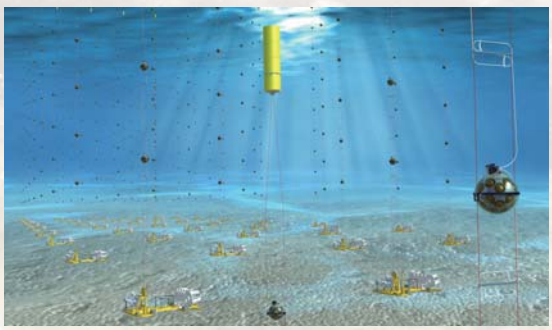


Transit time spread (FWHM) (Typ.)



Next generation neutrino telescope KM3NeT

In the depths of the Mediterranean Sea, a total of 6210 DOMs (Digital Optical Modules) will be installed, each of which incorporates photomultiplier tubes, operating circuits, and readout circuits. These modules are for use in ORCA (Oscillation Research with Cosmics in the Abyss) that will be conducted off the coast of Marseille, France for observation of low-energy neutrinos and are also for use in ARCA (Astroparticle Research with Cosmics in the Abyss) that will be conducted off the coast of Sicily, Italy for observation of high-energy neutrinos.



Courtesy of Edward Berbee / Nikhef

DOM (Digital Optical Module)

Courtesy of the KM3NeT Collaboration

Photomultiplier Tube R15458

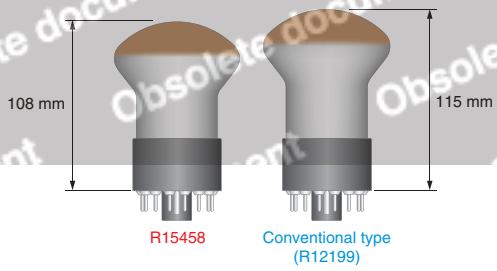
NEW

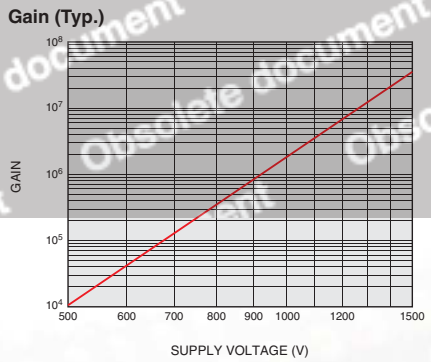
3-inch diameter, low-profile hemispherical photomultiplier tube with high gain

The R15458 is a small-diameter hemispherical photomultiplier tube with high gain designed for use with the 12-country collaboration project IceCube Neutrino Observatory. Compared to the conventional hemispherical photomultiplier tube (R12199), the R15458 is designed with a shorter overall length that helps reduce the size of the detection unit called the mDOM (multi-PMT Digital Optical Module).

Features

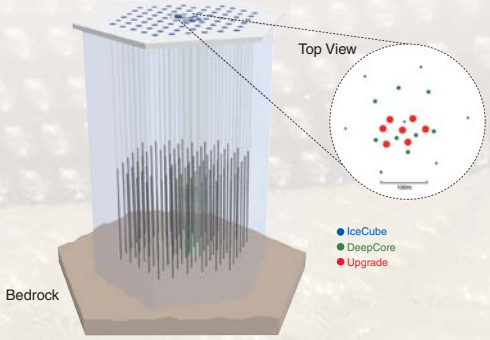
- High gain: 1.0×10^7 (typ.)
- Low profile





IceCube neutrino observatory

At a depth of 1500 to 2500 meters in the Antarctic ice, a total of 5160 DOMs (Digital Optical Modules) were installed, each of which incorporates photomultiplier tubes, operating circuits, and readout circuits. One cubic kilometer of Antarctic ice is used for neutrino detection. At present, an upgrade plan for the IceCube experiment is underway to add new 700 photodetectors to the currently used 5160 DOMs. More than half of those new photodetectors will be mDOM equipped with R15458.



Courtesy of the IceCube Collaboration

mDOM (multi-PMT Digital Optical Module)

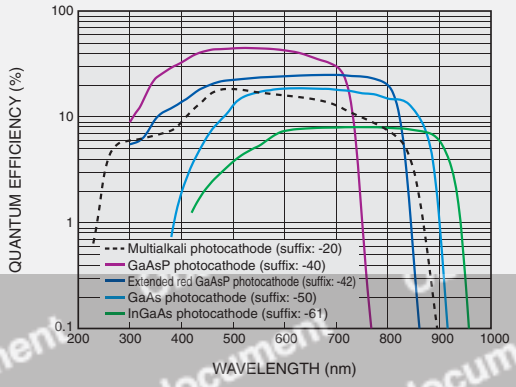
Courtesy of IKP, U Münster / A. Kappes

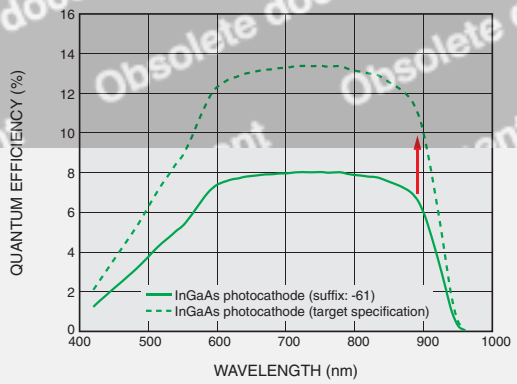
Laser Microscopy

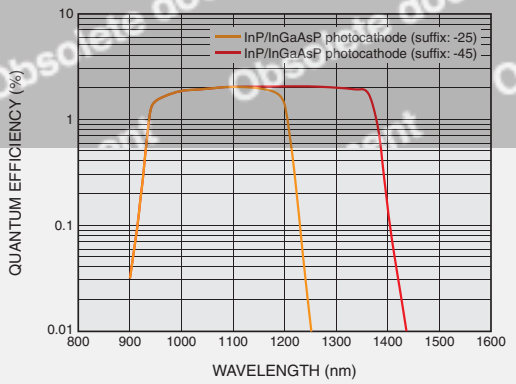
In confocal laser microscopes and multiphoton excitation microscopes for laser microscopy, our photosensor modules that incorporate a photomultiplier tube or HPD (hybrid photo-detector) are becoming more and more widely used as detectors for capturing fluorescence and scattered light from the sample.

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, InGaAs photocathode, and InP/InGaAsP photocathode that have high sensitivity in longer wavelength regions.

Spectral response (Typ.)







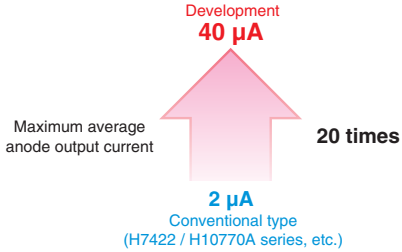
For Better Image Contrast Without Protection Circuit

Photosensor Modules (GaAsP Photocathode) - Wide Dynamic Range Type

Devlp.

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 µA providing clear images with sharp contrast and also ensuring stable operation without needing a protection circuit.



Gate Function for Optogenetics

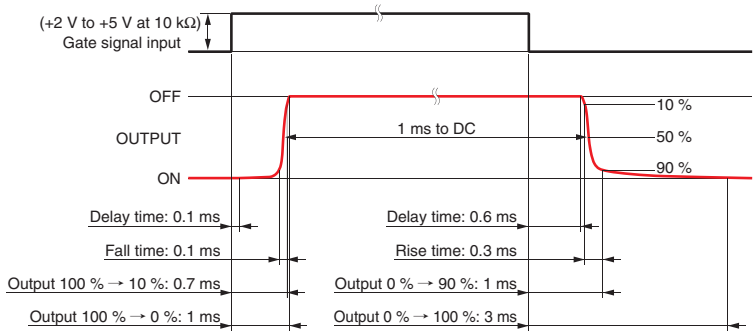
Photosensor Module (GaAsP Photocathode) H12056-40

Devlp.

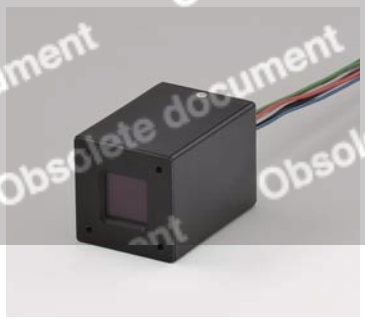
Miniature size photomultiplier tube module with gate function from 1 ms to DC

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.)



10× Larger Area for 2-Photon Microscopy

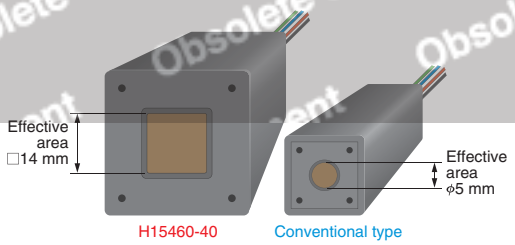


Photosensor Module (GaAsP Photocathode) H15460-40

Devlp.

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

The H15460-40 photosensor module employs a GaAsP photocathode photomultiplier tube. The photosensitive 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/μA.



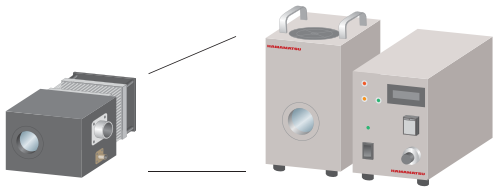
For NIR Detection

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

Devlp.

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.



H15620-25 / -45

(W) 120 mm × (H) 60 mm × (D) 60 mm
(except for heatsink and fan)

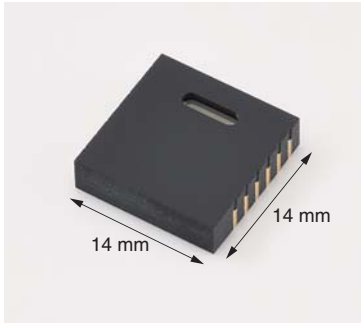
Conventional type
(H10330C series)

Main unit: (W) 100 mm × (H) 198 mm × (D) 150 mm
Controller unit: (W) 102 mm × (H) 143 mm × (D) 279.5 mm

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.

The world’s smallest photomultiplier tubes sealed in a subminiature package that increases design flexibility



Surface-Mount Package Micro PMT R12900U Series

NEW

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

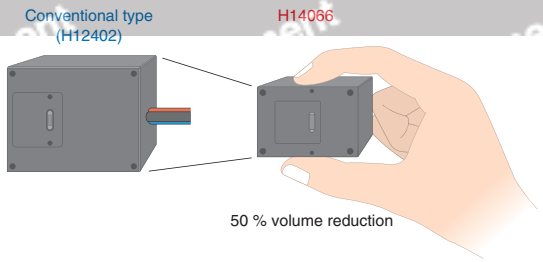
The R12900U series is a micro PMT encapsulated in a plastic package designed for easy mounting by the user onto electronic circuit boards. To meet increasing demands for more portable equipment, the R12900U series offers great features including a smaller size, thinner profile, lighter weight and easier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

Micro PMT Module H14066 Series

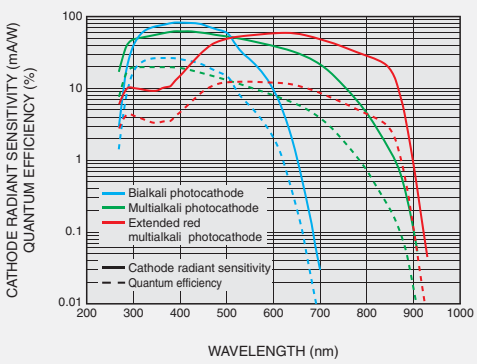
NEW

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

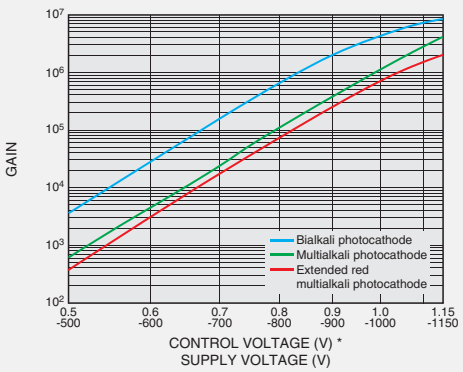
The H14066 series is the world’s smallest micro PMT module that integrates a micro PMT with a voltage-divider circuit and a high-voltage power supply circuit. The H14066 series incorporates an R12900U series surface-mount package micro PMT. Compared with our currently available micro PMT module (H12402), 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.



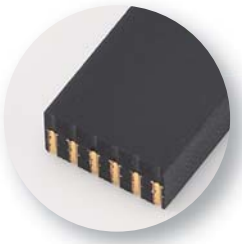
Spectral response (Typ.)



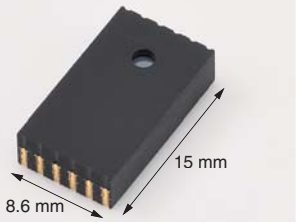
Gain (Typ.)



* Control voltage of a micro PMT module.



Array devices enabling multi-channel measurement



Surface-Mount Package Micro PMT R15320U Series

Devlp.

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 by the user onto electronic circuit boards. The package size is further reduced to 8.6 mm × 15 mm. Two or more micro PMTs can be arrayed in parallel to allow equipment downsizing and also to meet demands for multi-functional use such as simultaneous analysis of multiple samples with just a single piece of equipment.

Back: H15690-014, Front: H15691-018

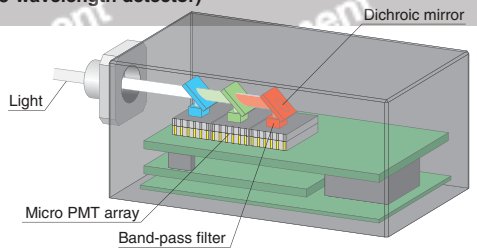
Micro PMT Arrays H15690-014, H15691-018

Devlp.

Photomultiplier tube modules capable of multi-channel measurement and multi-wavelength detection

The H15690-014 and H15691-018 are 4-channel and 8-channel micro PMT arrays using the R15320U series surface-mount package micro PMTs, which are arrayed in parallel at a center-to-center spacing of 9 mm. These micro PMT arrays allow multi-channel simultaneous measurement and multi-wavelength measurement with no crosstalk since each channel is fully separated. The number of channels and other specs can be customized to match user needs. We are also developing micro PMT arrays with an optical system so please consult us if interested.

Example of micro PMT array with optical system (3-wavelength detector)



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).

Applications

- Environmental analysis
- Specimen test (POCT: point-of-care testing)
- Various portable devices

TO-8 Package Photomultiplier Tubes

Hamamatsu Photonics also provides TO (transistor outline) package photomultiplier tubes that incorporate metal channel dynodes created by taking advantage of our advanced microfabrication technology. These photomultiplier tubes feature compact size, light weight and fast time response, making them useful across a wide range of fields and applications including radiation measurement, semiconductor wafer inspection, and specimen tests.

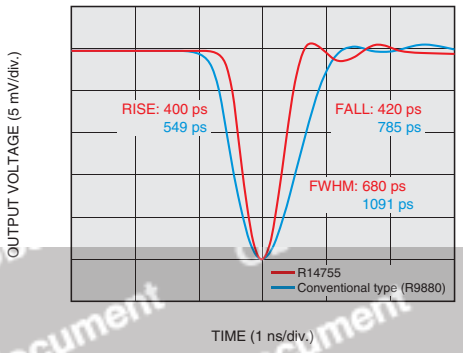
Metal Package Photomultiplier Tube R14755U-100

NEW

Photomultiplier tube with fast time response ideal for high-speed optical measurement

The R14755U-100 is a metal package photomultiplier tube with a fast response of 800 MHz, developed for high-speed optical measurement such as underwater optical communication and electron beam detection. Compared to the conventional type (R9880), the time response is now twice as fast due to modification of the internal structure.

Time response (Typ.)



Metal Package Photomultiplier Tube R9880U-09

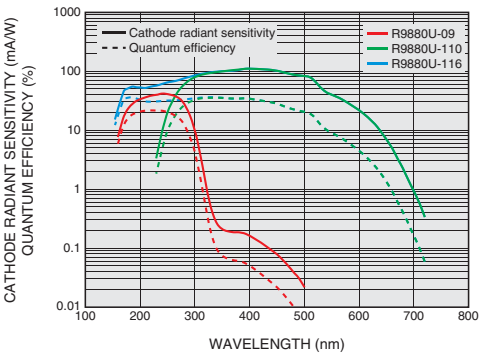
Devlp.

Photomultiplier tube with excellent solar blind spectral response

The R9880U series photomultiplier tubes deliver higher gain (approx. 5 times) and higher quantum efficiency (approx. 1.6 times*) when compared to the conventional (R9875). The R9880U-09, which is newly added to the lineup of the R9880U series, has a Cs-Te photocathode with excellent solar blind characteristics (spectral response range: 160 to 320 nm). The R9880U-09 can in this way detect low level light in the vacuum ultraviolet region for atomic absorption spectroscopy, optical emission spectroscopy, and other photometric applications.

* Quantum efficiency at 254 nm

Spectral response (Typ.)



Photomultiplier Tube Modules

We are continually designing and developing various types of photomultiplier tube modules to meet requirements in a diverse range of measurement applications. Our product lineup includes a wide array of versatile photomultiplier tube modules that vary in shape, characteristics, output configuration, and functions to let users choose the optimal product that best matches their needs and applications.

Linear-Array Multianode Photomultiplier Tube Module H15441-20

Devlp.

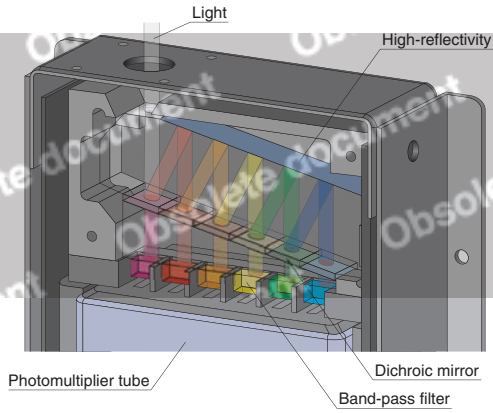
Photomultiplier tube module capable of simultaneous multi-wavelength measurement with high accuracy

The H15441-20 is designed to function as a 6-channel spectrum detector. Compared to the conventional type (H13457-20) mainly designed for optical fibers with an effective fiber core diameter of 400 µm, the H15441-20 supports optical fibers with larger core diameters up to 1000 µm.

Applications

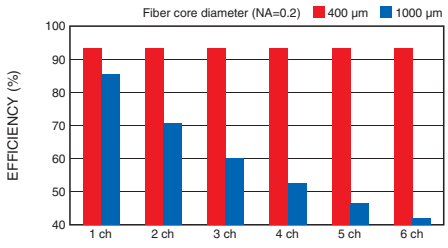
- Biomedical fluorescence detection
- Flow cytometry

Internal structure

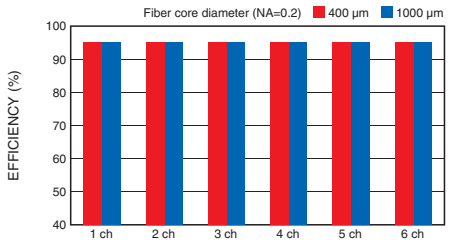


Spectral efficiency of filter optics (Typ.)

●Conventional type (H13457-20)



●H15441-20



Left: H14447, Right: H14990

Photosensor Modules H14447, H14990

Devlp.

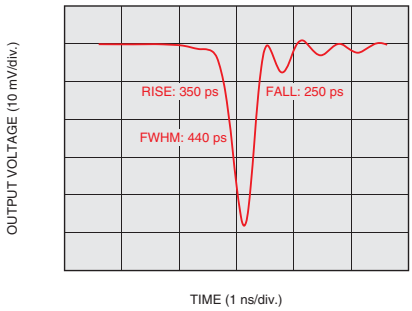
Photomultiplier tube modules capable of 1 Gbps communication

The H14447 and H14990 are photosensor modules having fast responses of 1 GHz and 0.7 GHz, respectively. Compared to the conventional type (H13661), the H14447 and H14990 offer improved ringing and fewer pulse height fluctuations in the output while also ensuring a wide opening in the eye pattern, making them more ideal for optical communication and laser radar (LiDAR).

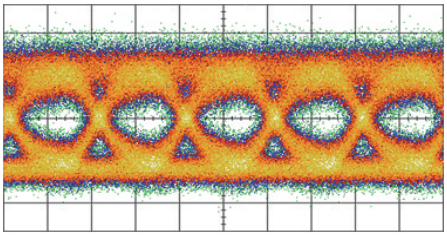
Applications

- Optical communication
- Laser radar (LiDAR)

Time response (Typ., H14447)



Eye pattern (1 Gbps) (Typ., H14447)



Left: H14950, Center: H14601, Right: H14953

Photosensor Modules H14601, H14950, H14953

Devlp.

Miniaturized photomultiplier tube modules that help the design of more portable equipment

These are miniaturized photosensor modules integrating a TO-8 package photomultiplier tube and a high-voltage power supply circuit. Compared to our currently available products (H10721, H11900 and H11903 series), the cubic volume is reduced by about 50% to help users design more portable equipment. The H14601 is a cable type with +5 V input and current output (same as our currently available H10721). The H14950 is a pin type with +15 V input and current output (same as our currently available H11900). The H14953 is a cable type with +15 V input and voltage output (same as our currently available H11903).

Applications

- Environmental measurement
- Specimen test (POCT: point-of-care testing)

Photosensor Module H14768

NEW

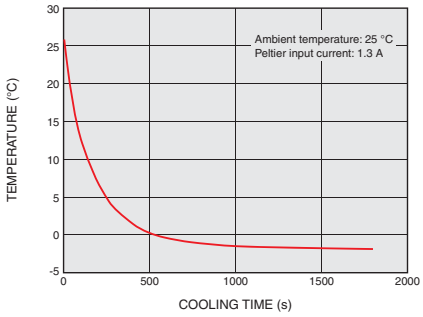
Photomultiplier tube module ideal for low-light-level detection in the near-infrared region

The H14768 is a photosensor module incorporating a side-on photomultiplier tube with a high-sensitivity multialkali photocathode along with a high-voltage power supply circuit and a thermoelectric cooler. Compared to the conventional type (H7844), the maximum cooling temperature is improved to reduce noise on low-light-level detection in the near-infrared region.

Applications

- NOx gas detection
- Fluorescence detection
- Chemiluminescence detection
- Near-infrared spectroscopy

Photocathode temperature vs. cooling time (Typ.)





Photon Counting Head H14870

NEW

Photomultiplier tube module capable of 16-channel photon counting

The H14870 photomultiplier tube module is designed specifically for MTP readers (microplate readers). It has the light input openings arranged at intervals equal to the well-to-well spacing for 96-well microplates and allows 16-channel simultaneous measurement with low crosstalk. This will significantly improve the throughput of MTP readers.

Applications

●MTP readers (microplate readers)

Wide Dynamic Range Photomultiplier Tube Module H13126-01

NEW

Photomultiplier tube module that ensures a wide dynamic range up to 10 log units in one measurement

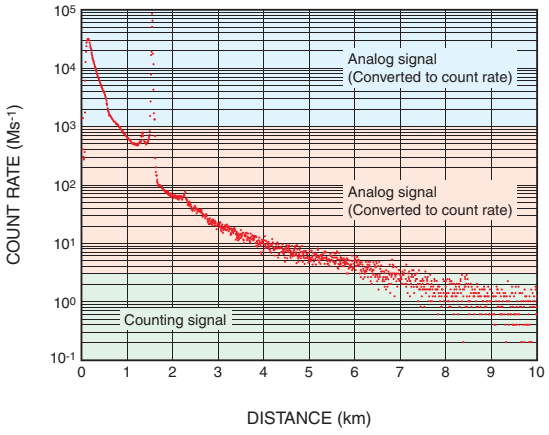
The H13126-01 is a compact photomultiplier tube module that allows continuous measurement each time with no time lag over a 10-log dynamic range and with just one unit. The H13126-01 provides a digital output for detecting low-level light counting signal and an analog output for detecting high-level visible light, both of which can be measured simultaneously.

Applications

●Laser radar (LiDAR)
●Fluorescence measurement
●Chemiluminescence measurement

Measurement example

In laser radar (LiDAR) systems for obtaining information on overhead clouds and aerosols by capturing scattered light of a laser beam transmitted into the atmosphere, the H13126-01 is used to make simultaneous measurements of three output signals: two analog signals and one counting signal.
The graph on the right shows the count rate versus distance data with a wide dynamic range, plotted by converting the analog signals to the count rate.



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 gas measurement, gas analysis, product inspection, and infrared spectroscopy.

Supercontinuum Light Source L15077

NEW

Near-infrared laser light source with a broad spectrum and high stability

The L15077 is a compact laser light source that uses broadband laser light generated by a nonlinear optical phenomenon utilizing an ultra-short pulsed laser. It provides high directivity and high brightness like that of a laser and a broadband spectrum like that of a lamp light source.

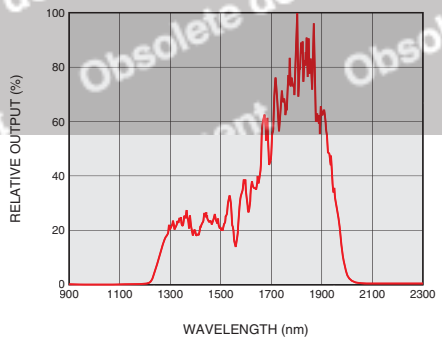
Features

- High stability: 0.1 % or less (typ.)
- Broad spectrum: 1300 nm to 2000 nm
- High brightness: Approx. 20,000 times (compared to halogen lamps)

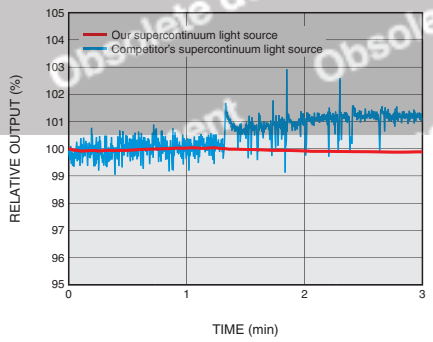
Applications

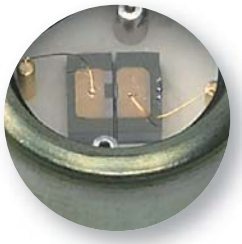
- Fourier transform near-infrared spectrophotometry (FT-NIR)
- Optical coherence tomography (OCT)
- Gas measurement and analysis
- Semiconductor wafer inspection
- Near-infrared spectroscopy

Spectral distribution (Typ.)



Output stability (Typ. at 1500 nm)





IR Graphene Light Source

Devlp.

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.

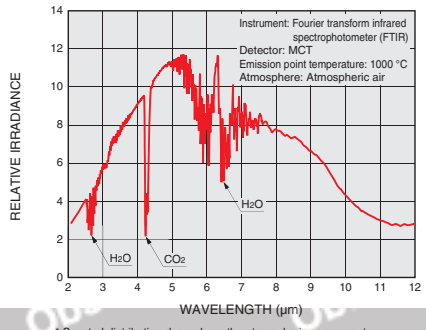
Features

- 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

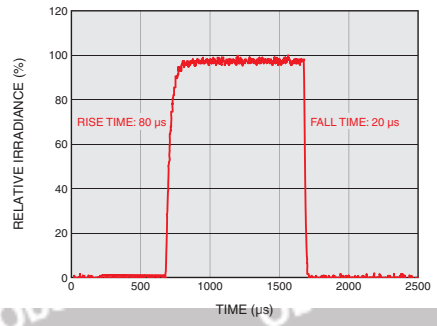
- Non-dispersive infrared (NDIR) gas sensor
- Fourier transform infrared spectrophotometer (FTIR)
- Breath monitor (CO_2, etc.)

Spectral distribution (Typ.)



* Spectral distribution depends on the atmospheric components.

Time response (Typ.)



Broad Infrared Spectrum 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.

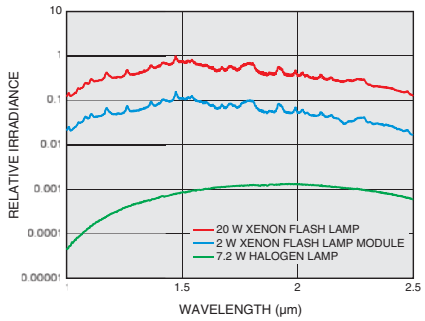
Features

- Broad spectrum: 160 nm to 7500 nm
- Momentarily high optical output:
  Approx. 1000 times (compared to halogen lamps)
- Low heat generation
- High stability
- Long life

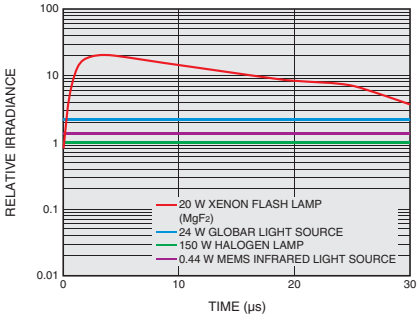
Applications

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

Spectral distribution (Typ.)



Emission pulse waveform (Typ.)



Detector: Spectrometer NIRQuest512-2.5 made by Ocean Optics
(slit width: 25 µm, integration time: 1 ms)
Optical fiber: MF11L1 made by Thorlabs (core diameter: 100 µm,
InF_3 transmission wavelength range: 0.3 µm to 5.5 µm)

* Light output depends on detector sensitivity.
Use this data as a reference for comparison with other infrared light sources.
* Light output of halogen lamp is corrected to peak irradiance of xenon flash lamp
(flash duration: approx. 6 µs)

Imaging Devices

Imaging technology, which enables high-precision inspection, measurement and analysis, is now used across a vast range of fields. We at Hamamatsu Photonics are continuing to develop sophisticated yet easy-to-use imaging devices such as for transmission imaging utilizing X-rays and neutrons, and low-light-level imaging in the UV to the near-infrared regions.

X-Ray Imaging

180 kV Microfocus X-Ray Source L14351-02

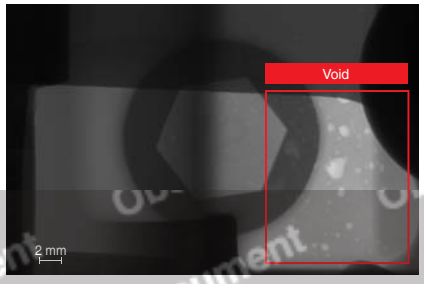
NEW

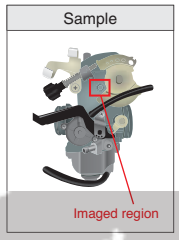
Sealed type X-ray source with the world's highest tube voltage of 180 kV maximum

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 in X-ray non-destructive inspections and X-ray CT using sealed type X-ray sources. It also improves the imaging speed.

Imaging example

●Automotive engine die casting





Tube voltage	180 kV
Tube current	300 µA

Soft X-Ray Source L11754-01

Devlp.

Soft X-ray source that operates at low energy for detecting foreign objects made of light elements

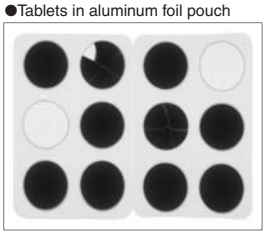
The L11754-01 is a soft X-ray source that operates at low energy (tube voltage: 15 kV, tube current: 1 mA) to allow finding foreign objects made of light elements that were difficult to detect up to now. The L11754-01 features compact size, light weight, easy shielding, and wide X-ray emission angle, making it optimal for inspection applications such as finding poor package sealing of foodstuffs and medicines or detecting misalignment of rechargeable battery separators.

Features

- ●High contrast imaging for light elements
- ●Compact, lightweight
- ●Easy shielding
- ●Wide emission angle

Imaging example

●Tablets in aluminum foil pouch



Compact X-Ray CMOS Camera Digital X-CUBE

Devlp.

High-sensitivity X-ray camera designed to smoothly and effortlessly capture high-quality X-ray images

Digital X-CUBE is a compact X-ray CMOS camera using a CMOS image sensor chip optically coupled to a high-sensitivity CsI scintillator. It gives high-sensitivity, high-quality X-ray images in the same easy way as when using ordinary CMOS cameras.

Neutron Imaging

High-Count-Rate Neutron Detector Unit

Technology

Neutron detector with built-in multi-channel readout circuit

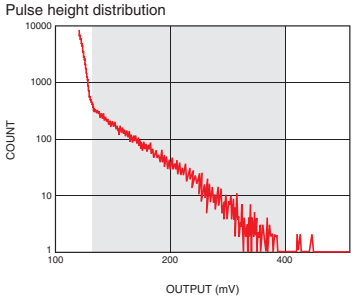
This high-count-rate neutron detector unit uses a multianode photomultiplier tube combined with a scintillator and readout circuit. To detect neutrons in a particular energy region, the detector unit comes with analysis software that can be customized to meet user needs. This detector unit is ideal for small-angle or backscatter imaging and supports imaging up to 256 channels.

Measurement example

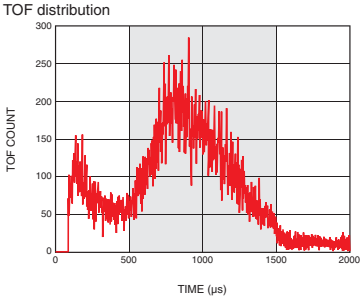
●Measurement data

The graphs show analysis data when pulsed neutrons were detected and integrated 100 times.
The gray area of the integration map is displayed by extracting data from noise-free regions of the TOF distribution and pulse height distribution graphs.

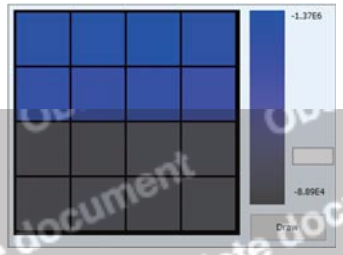
Pulse height distribution



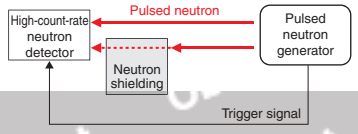
TOF distribution



Integration map



Measurement block diagram



Imaging Devices

Low-Light-Level Imaging

C-mount type

F-mount type

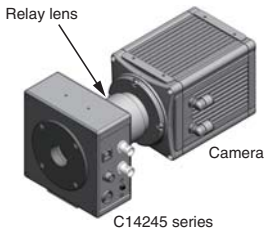
High-Speed Gated Image Intensifier Unit C14245 Series

NEW

Compact image intensifier unit with gate function of 3 ns to DC

The C14245 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-shape configuration. The standard lens mount of the C14245 is a C-mount but can be easily changed to an F-mount if needed.

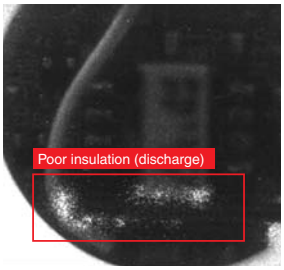
Connection example



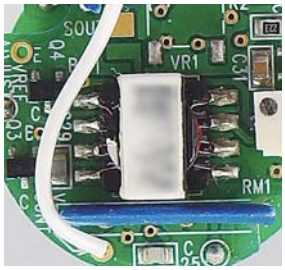
Imaging example

●Observation of discharges on PC board

Image captured with C14245



Ordinary visible image



Static Charge Removers

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.

L15094

VUV Ionizers L12542, L15094

NEW

Static charge removers that neutralize static charges across large areas with greater efficiency

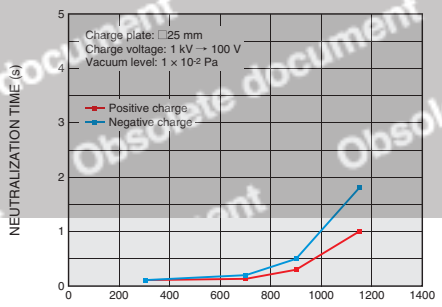
The L12542 and L15094 eliminate static charges in a vacuum by utilizing vacuum UV light. Due to their greatly improved neutralization performance over larger areas, they can handle a variety of objects with large surface areas, with heavy electrical charges, or moving on high-speed conveyors and in this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

Applications

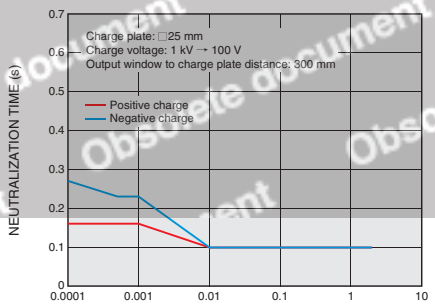
- Electrostatic dechucking
- Semiconductor manufacturing
- Liquid crystal and organic EL display manufacturing
- Film manufacturing
- Equipment using electron beams (SEM, etc.)

Neutralization performance (Typ., L12542)

●Neutralization time vs. distance



●Neutralization time vs. vacuum level



L14471, C14472

Photolonizers L14471, C14472, C14546

NEW

Static charge removers designed to drive multiple ionizer heads for extracting maximum neutralization performance

These photoionizers use soft X-rays to neutralize static charges in the atmosphere and are designed to drive 2 or 4 ionizer heads to boost neutralization performance to the maximum level. 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 shorten the neutralization time.

Applications

- Semiconductor manufacturing
- Component mounting in chip mounter
- Liquid crystal and organic EL display manufacturing
- Film manufacturing
- Lithium ion rechargeable battery manufacturing
- Printing, painting

High-Voltage Power Supply Modules

As a leading manufacturer of high-sensitivity photosensors and photomultiplier tubes, Hamamatsu Photonics offers high-voltage power supplies with advanced features utilizing technologies that have been developed and accumulated over many years. Our high-voltage power supplies help to improve reliability in a wide range of applications including mass spectrometers, scanning electron microscopes (SEM), and electrostatic chucks.

High-Voltage Power Supply Module C14051-55

NEW

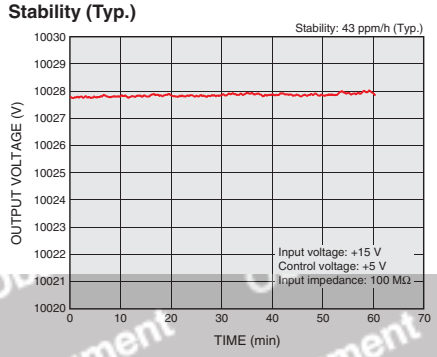
Regulated high-voltage DC power supply capable of high voltage output up to +10 kV and 200 µA

The C14051-55 is a compact, high-efficiency, high-voltage power supply designed to provide high voltage output up to +10 kV and 200 µA. The C14051-55 is provided with high safety by comprising a double insulation structure and various protective function. It also has wide input voltage range and output monitor (voltage / current). So it is suitable for incorporating to apparatus.

Features

- High voltage output: Maximum +10 kV and 200 µA
- Wide input voltage range: +11 V to +16 V
- Output monitor (voltage / current) included
- Safety design with multiple protective functions

Stability (Typ.)



High-Voltage Power Supply Module C14921-01

Devlp.

Regulated bipolar high-voltage power supply that provides output varied continuously from -5 kV to +5 kV without switching beforehand

The C14921-01 is a bipolar high-voltage power supply with a maximum output of ±5 kV and 200 µA. Our previous models of high-voltage power supplies are single-polarity types or dual-polarity types required with switching polarity beforehand. The C14921-01, makes it possible to control the output voltage continuously by using controlling voltage without requiring a switch or selector.

Features

- Bipolar output: Maximum ±5 kV and 200 µA
- Polarity switching by control voltage
- High-speed time response: 250 µs (10 % to 90 %)
- Output monitor (voltage / current) included

HAMAMATSU

PHOTON IS OUR BUSINESS

Electron Tube Division, HAMAMATSU PHOTONICS K.K.
314-5, Shimokanzo, Iwata City, Shizuoka Pref., 438-0193, Japan
Telephone: (81)539/62-5248, Fax: (81)539/62-2205
www.hamamatsu.com

Main Products

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

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

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

Laser Products
Semiconductor lasers
Applied products of semiconductor lasers
Solid state lasers

REVISED APR. 2020

Quality, technology and service are part of every product.

Sales Offices

Japan:
HAMAMATSU PHOTONICS K.K.
325-6, Sunayama-cho, Naka-ku,
Hamamatsu City, Shizuoka Pref. 430-8587, Japan
Telephone: (81)53-452-2141, Fax: (81)53-456-7889
E-mail: intl-div@hq.hpk.co.jp

China:
HAMAMATSU PHOTONICS (CHINA) Co., Ltd.
Main Office
1201 Tower B, Jiaming Center, 27 Dongsanhuan Beilu,
Chaoyang District, 100020 Beijing, P.R. China
Telephone: (86)10-6586-6006, Fax: (86)10-6586-2866
E-mail: hpc@hamamatsu.com.cn

Shanghai Branch
4905 Wheelock Square, 1717 Nanjing Road West,
Jingan District, 200040 Shanghai, P.R. China
Telephone: (86)21-6089-7018, Fax: (86)21-6089-7017

Taiwan:
HAMAMATSU PHOTONICS TAIWAN Co., Ltd.
Main Office
8F-3, No. 158, Section 2, Gongdao 5th Road,
East District, Hsinchu, 300, Taiwan R.O.C.
Telephone: (886)3-659-0080, Fax: (886)3-659-0081
E-mail: info@hamamatsu.com.tw

U.S.A.:
HAMAMATSU CORPORATION
Main Office
360 Foothill Road, Bridgewater, NJ 08807, U.S.A.
Telephone: (1)908-231-0960, Fax: (1)908-231-1218
E-mail: usa@hamamatsu.com

California Office
2875 Moorpark Ave., San Jose, CA 95128, U.S.A.
Telephone: (1)408-261-2022, Fax: (1)408-261-2522
E-mail: usa@hamamatsu.com

Chicago Office
4711 W. Golf Road, Suite 805, Skokie, IL 60076, U.S.A.
Telephone: (1)847-825-6046, Fax: (1)847-825-2189
E-mail: usa@hamamatsu.com

Boston Office
20 Park Plaza, Suite 312, Boston, MA 02116, U.S.A.
Telephone: (1)617-536-9900, Fax: (1)617-536-9901
E-mail: usa@hamamatsu.com

United Kingdom:
HAMAMATSU PHOTONICS UK Limited
Main Office
2 Howard Court, 10 Tewin Road, Welwyn Garden City,
Hertfordshire AL7 1BW, UK
Telephone: (44)1707-294888, Fax: (44)1707-325777
E-mail: info@hamamatsu.co.uk

South Africa Contact:
9 Beukes Avenue, Highway Gardens, Edenvale
1609 South Africa
Telephone/Fax: (27)11-609-0367

France, Portugal, Belgium, Switzerland, Spain:
HAMAMATSU PHOTONICS FRANCE S.A.R.L.
Main Office
19, Rue du Saule Trapu, Parc du Moulin de Massy,
91882 Massy Cedex, France
Telephone: (33)1 69 53 71 00, Fax: (33)1 69 53 71 10
E-mail: infos@hamamatsu.fr

Swiss Office
Dornacherplatz 7, 4500 Solothurn, Switzerland
Telephone: (41)32-625-60-60, Fax: (41)32-625-60-61
E-mail: swiss@hamamatsu.ch

Belgian Office
Axisparc Technology, rue Andre Dumont 7
1435 Mont-Saint-Guibert, Belgium
Telephone: (32)10 45 63 34, Fax: (32)10 45 63 67
E-mail: info@hamamatsu.be

Spanish Office
C. Argenters, 4 edif 2 Parque Tecnológico del Vallés
08290 Cerdanyola (Barcelona), Spain
Telephone: (34)93 582 44 30, Fax: (34)93 582 44 31
E-mail: infospain@hamamatsu.es

Germany, Denmark, The Netherlands, Poland, Israel:
HAMAMATSU PHOTONICS DEUTSCHLAND GmbH
Main Office
Arzbergerstr. 10, D-82211 Herrsching am Ammersee,
Germany
Telephone: (49)8152-375-0, Fax: (49)8152-265-8
E-mail: info@hamamatsu.de

Danish Office
Lautruphøj 1-3, DK-2750 Ballerup, Denmark
Telephone: (45)70 20 93 69, Fax: (45)44 20 99 10
Email: info@hamamatsu.dk

Netherlands Office
Transistorstraat 7, NL-1322 CJ Almere, The Netherlands
Telephone: (31)36-5405384, Fax: (31)36-5244948
E-mail: info@hamamatsu.nl

Poland Office
10 Ciolka Street, RN 126-127 01-402 Warsaw, Poland
Telephone: (48)22-646-0016, Fax: (48)22-646-0018
E-mail: poland@hamamatsu.de

Israel Office (Hamamatsu Photonics Israel Ltd.)
Hahoshlim 6, Building C, 4672201 Herzliya, Israel
E-mail: Info@hamamatsu.co.il

North Europe and CIS:
HAMAMATSU PHOTONICS NORDEN AB
Main Office
Torshamnsgatan 35 16440 Kista, Sweden
Telephone: (46)8-509 031 00, Fax: (46)8-509 031 01
E-mail: info@hamamatsu.se

Russian Office
11, Christoprudny Boulevard, Building 1, Office 114,
101000, Moscow, Russia
Telephone: (7)495 258 85 18, Fax: (7)495 258 85 19
E-mail: info@hamamatsu.ru

Italy:
HAMAMATSU PHOTONICS ITALIA S.r.l.
Main Office
Strada della Moia, 1 int. 6, 20020 Arese (Milano), Italy
Telephone: (39)02-93 58 17 33, Fax: (39)02-93 58 17 41
E-mail: info@hamamatsu.it

Rome Office
Viale Cesare Pavese, 435, 00144 Roma, Italy
Telephone: (39)06-50 51 34 54
E-mail: inforoma@hamamatsu.it

TOTH0029E02
APR. 2020 IP